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Feed Efficiency and Blood Profiles of West African Dwarf Goats Fed *Pleurotus tuber-regium* Biodegraded Rice Straw and Maize Offal -Brewer Yeast Slurry Mixture

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Authors' contributions

This work was carried out in collaboration between both authors. Author AAW undertook the practical work, performed the statistical analysis, managed the analyses of the study, managed the literature searches and wrote the first draft of the manuscript. Author SNC designed the study, wrote the protocol and edited the first draft of the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

Aim: This study was conducted to evaluate the effect of feeding *Pleurotus Tuber-regium* biodegraded rice straw (PTTRS) and maize offal: brewer yeast slurry mixture (MOBYS) on feed efficiency, haematological and serum biochemical profiles of West African Dwarf (WAD) goats.
Study Design: The Completely Randomized Design was used for the study.
Place and Duration of the Study: The study was conducted at the Sheep and Goat Unit section of the University of Agriculture Makurdi Livestock Teaching and Research Farm, Makurdi, Nigeria. Makurdi is located at Latitude 7º 43¹ N and Longitude 8º 31¹ E. The experiment lasted for 90 days.
Methodology: Twenty four West African Dwarf (WAD) goats weighing 8.05 kg on the average were allotted to six groups of four goats per treatment in a Completely Randomized Design for the study. The six dietary treatment groups were fed varying levels of MOBYS, and *ad libitum,* untreated rice straw (UTRS) and *Pleurotus tuberregium* treated rice straw (PTTRS) thus: T1= 100 g MOBYS and UTRS (control) *ad libitum,* T2=100 g MOBYS and PTTRS *ad libitum*, T3=200 g

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MOBYS and UTRS *ad libitum*, T4=200 g MOBYS and PTTRS *ad libitum*, T5=300 g MOBYS and UTRS *ad libitum*, and T6=300 g MOBYS and PTTRS *ad libitum.* Parameters measured were feed efficiency, haematological and serum biochemical profiles**.** On the last day of the study, blood was collected from jugular veins of the goats into previously prepared tubes and sent for analysis. The blood was analysed for haematological and serum biochemistry parameters using Midray 3500 Autohaematology Analyzer. Feed efficiency was calculated as the difference in weight between the final and initial weights divided by the amount of feed consumed between the dates the initial and final body weights were taken

Results: Feed efficiency values were 0.059, 0.061, 0.066, 0.068, 0.068 and 0.069 Kg for T1, T2, T3, T4, T5 and T6 respectively and the values showed a significant difference (P=.03). Values obtained for haematological parameters for T1, T2, T3, T4, T5 and T6 were as follows: Packed cell volume (PCV) 24.20, 24.80, 26.30, 27.00, 30.40 and 30.80%; haemoglobin (Hb) 8.50, 8.52, 9.02, 9.25, 11.20 and 11.40 g/dl; red blood cells (RBC) 13.10, 13.00, 14.12, 14.72, 15.80 and 16.20 x 10^6 ul; white blood cells (WBC) 8.10, 8.70, 8.80, 8.60, 8.10 and 8.70 x 10^6 ul; mean corpuscular volume (MCV) 22.85, 23.20, 23.70, 23.80, 24.20 and 24.80 fl; mean corpuscular haemoglobin (MCH) 6.93, 7.02, 7.07, 7.10, 7.24 and 7.36 pg and mean corpuscular haemoglobin concentration (MCHC) 33.10, 33.40, 32.80, 33.50, 33.40 and 33.00 g/dl respectively while corresponding values for the serum biochemical parameters were: urea 17.21, 17.00, 17.30, 17.80, 17.50 and 17.60 mmol; total protein (TP) 68.60, 68.30, 69.10, 69.00, 70.70 and 70.80 g/dl; albumin (ALB) 32.10, 32.0, 32.0, 32.3, 32.8 and 32.90 g/dl; globulin (GBL) 46.48, 46.28, 46.85, 46.68, 47.88 and 47.90 g/dl; Serum Glutamic Oxaloacetic Transaminase (SGOT) 198.10, 198.60, 198.60, 198.10, 198.80 and 198.90 iu/l; Serum Glutamic Pyruvic Transaminase (SGPT) 95.30, 96.10, 95.80, 96.00, 95.60 and 95.40 mg/dl and creatinine 101.20, 103.00, 102.10, 103.20, 102.80 and 103.00 umol/l respectively. Significant differences were observed in only the PCV (P=.03), Hb (P=.02), RBC (P=.01), GBL (P=.02) and creatinine (P=.04); in general all the haematological and serum biochemical profile values were within the reference ranges.

Conclusion: It was concluded that feeding the test inputs at increasing levels improved the feed efficiency, haematological and serum biochemical parameters of the West African Dwarf goats.

Keywords: Feed- efficiency; blood- profiles; rice- straw; biodegraded; maize -offal; brewer –yeast-slurry.

1. INTRODUCTION

Many evaluation tools are used to assess the efficacy of production by farm animals to enable quality decision making. One of such tools is feed efficiency which assesses how much of a product that is produced per unit of feed. This assessment is important because feed cost contributes substantially to farm cost; additionally feed is a very critical input that must be utilized at the best options. Factors affecting feed efficiency include genetics, environment and diet. Feed efficiency can be improved by increasing diet digestibility, increasing forage fibre (NDF) digestibility, stimulating rumen microbial digestion, optimising feed intake, maintaining the animal in an adequate environment, in optimal health and management and optimal growth rates [1]. The transformation of food energy into products of animal origin, as in any other energy transformation system, is not devoid of losses since there is an efficiency by which the food energy is used for maintenance and production [2]. Feed efficiency values of 0.122 and 0.167 Kg for Spanish and Tennessee Stiff – legged breeds from weaning to six months and 0.088 and 0.104 Kg from nine to 13 months respectively were reported [3] implying that the Tennessee Stiff – legged breed was more efficient in converting feed to weight gain compared to the Spanish breed. The authors also asserted that feed intake is one of the most important factors in allowing meat animals to express their genetic potentials.

Blood performs an important role in the overall well being of the animal. It is often difficult to assess the correct health status of an animal without recourse to an examination of its blood, as it is a fast and readily available technique employed in assessing clinical, nutritional and health status of animals, as well as giving some insight into their production performance potential [4]. Baseline data on haematological and biochemical values could be used for diagnosis of disease, for criteria of adaptability as well as to elucidate some physiological mechanisms in WAD goats [5]. Haematological parameters assessment is an essential and reliable medium used to monitor and evaluate health and nutrition status of animals [6]; are

valuable in monitoring feed toxicity, especially with feed constituents that affect the blood as well as the health status of farm animals [7]. Nutrition is one of the factors that influence blood chemistry [8]. Although body weight measurement and body condition scoring are easier to perform and cheaper to determine, they have limitations that can be complemented by the use of blood metabolites and haematology [9]. The authors also added that blood metabolite profiling provides useful information such as the occurrence of adverse energy balance, under nutrition and the presence of disease. It is expected that where feeds are most efficiently utilized, there should be a corresponding blood picture to support such assertion. The aim of the study was to evaluate the feed efficiency and blood profiles of West African Dwarf goats fed *pleurotus tuber-regium* biodegraded rice straw and maize offal –brewer yeast slurry mixture.

2. MATERIALS AND METHODS

2.1 Preparation of Feed Materials

2.1.1 Gathering and processing rice straw

Rice straw was gathered from rice farms around University of Agriculture, Makurdi environs after rice was harvested and threshed. It was baled and kept in store to prevent rain water from possibly wetting and spoiling it. Later, the rice straw was milled using a blur mill to reduce its particle size and create a greater surface area for microbial activity. The milled straw was then put in sacks and stored until required for use.

2.1.2 Mass composting of rice straw for experimental feeding of goats

2.1.2.1 Preparation of inoculation rooms

Floors, walls and doors of the inoculation room were swept, washed and disinfected using Dettol disinfectant in water at the rate of one litre Dettol to four litres of water. The floors were then mopped free of water and the doors left open for one week to enable drying of the room.

2.1.2.2 Composting of milled rice straw

The milled rice straw was wetted with water at the rate of one kg straw to two litres of water and thoroughly mixed to enable complete wetting of the straw. Then the straw was heaped in one place and covered using polyethylene sheets to create an airtight environment suitable for composting [10]. The straw heap was turned inside out every other day for a total period of seven days after which the heap was spread out to enable cooling of the composted straw.

2.1.2.3 Fungal inoculation of the straw

Tubers of *Pleurotus tuberregium* (PTR), obtained from dealers were weighed, washed and soaked in water for one hour after which they were removed and put in white transparent buckets and covered for two days to enable spore formation of the tubers. After two days, the PTR tubers were removed and dissected to smaller bits carrying the spores. The composted straw was loaded on three tier wooden trays of dimension 1.5 m x 1.2 m x 0.75 m (height, breadth and width) constructed using 2x2" wood and wire mesh base. The base of the wooden tray was covered with white transparent polyethylene sheet disinfected using methylated spirit soaked cotton wool. Spores of PTR were then inoculated into the composted rice straw at the rate of one kg spores to five kg straw. The ends of the polyethylene sheets were then brought together and sealed using masking tape to create an airtight environment. Water was then poured on the room floor and some left in buckets after which doors of the inoculation room were closed. After 30 days, the mass of composted straw now colonized by mycelium of the fungi showing whitish growths was taken out of the inoculation trays from the inoculation room and sun dried to terminate growth of the fungi and dry the material. The material was then sun dried and then put in sacks and stored until required for use.

2.1.3 Maize offal: brewer yeast slurry mixture (MOBYS) preparation

Maize offal was bought from mills, sun dried and stored in sacks. Brewer yeast slurry was collected from Benue Brewery Limited, Makurdi, Nigeria, moved to the drying site and mixed with maize offal in the ratio of 1:1 by weight and sun dried with constant turning to prevent lumps from following. After sun drying, the MOBYS was then put in sacks and stored.

2.2 Goat Pen Preparation

The goat pen having cages for individual housing and feeding of the goats were used. The individual cages were constructed using 2x2" wood with lockable doors. Dimensions of the cages were 1.27 m x 1.2 m x 0.7 m (height, breadth and width). The cages were thoroughly swept, washed, disinfected and left to dry. The

entire pen was then fumigated using Sniper (2, 3 – dichlorovinyl dimethyl phosphate) and Marshal (Lambda – cyhalothrin 2.5 EC) at the rate of 3 ml to 200 ml water and 20 ml to 20 liters water respectively. The feeding troughs were constructed using wooden planks and were of the dimension 0.25 m x 0.25 m x 0.30 m (height, breadth and width).

2.3 Acquisition of Goats/ Acclimatization

24 Young WAD bucks weighing 8.05 kg on the average were sourced from areas of the state where vaccination against PPR had been carried out and conveyed to the farm. They were then exposed to a 30 day acclimatization period during which they were given prophylactics against endo and ectoparasites and a general antibiotic cover thus: Terramycin (long acting) @ 1.0 ml per goat, Eagle vitaflash @ 0.5 ml per goat, Pour on @ 1.0 ml per goat administered at backline of the goats, ivermectin @ 1.0 ml per 10kg live weight and iron Dextrant @ 1.0 ml per goat. Acclimatization drug administration was completed one week to end of the acclimatization period, at the end of which, the goats were then randomly allocated to the six dietary treatments and caged individually.

2.4 Animal Feeding

The goats were then exposed to the following dietary treatments for 90 days:

T1 = 100 g MOBYS and untreated straw (RS) *ad libitum*
T2 = 100 g MOBYS and *Pleurotus tuberregium* treated rice straw (PTRRS) *ad libitum*
T3 = 200 g MOBYS and RS *ad libitum*
T4 = 200 g MOBYS and PTRRS *ad libitum*
T5 = 300 g MOBYS and RS *ad libitum*
T6 = 300 g MOBYS and PTRRS *ad libitum*

Four goats were used per treatment with each goat forming a replicate. The goats were also served water and Yalama Blogu Royal Mineral Licking Block *ad libitum.* Their drinking water and MOBYS were put in poultry chick drinkers and inserted into the feeding troughs while the untreated rice straw and PTTRS were served directly in the feeding troughs.

2.5 Parameters Assessment

2.5.1 Feed efficiency estimation

Feed efficiency was calculated as the difference in weight between the final and initial weights divided by the amount of feed consumed between the dates the initial and final body weights were taken [3].

2.5.2 Blood parameters assessment

On the last day of the study, blood was collected from jugular veins of the goats into previously prepared tubes and sent for analysis. The blood was analyzed for haematological and serum biochemistry parameters using Midray 3500 Autohaematology Analyzer within one hour of collection at the laboratory of the University of Agriculture, Makurdi Veterinary Teaching Hospital.

2.5.3 Experimental design and statistical analysis

The experimental design used was the Completely Randomized Design. Data obtained were analyzed using Minitab Statistical Software [11], while significant differences in means were separated using Duncan Multiple Range Test as outlined by Steel and Torrie [12].

3. RESULTS

3.1 Feed Efficiency

Table 1 shows the feed intake, weight gain and feed efficiency values of the experimental goats. Both the feed intake and weight gain showed similarity in being highest in T6, followed by T5, then T4 and T3, and lastly T1 and T2; they also showed a similar pattern of significant difference (P=.00) where T6 and T5 were similar to each other but different from the rest of the treatments, T4 and T3 were also similar to each but different from T2 and T1 which were also similar to each other. The feed efficiency values were highest in T6, followed by T5, then T4, T3 and T2 while T1 had the least value; they showed significant difference (P=.03) where T6, T5, T4 and T3 were similar in themselves but higher than T1 and T2 which were similar to each other. In general there were increases in the parametric values with increasing MOBYS intake.

3.2 Haematological Profile

The haematological profile of the experimental goats is shown in Table 2. The results differed Significantly PCV (P=.03), Hb (P=.02) and RBC (P=.01) and showed a similar pattern where highest values were obtained for T5 and T6, which were higher than T3 and T4 values which

were also significantly higher than values of T1 and T2 which were similar to each other. These values increased with increasing MOBYS intake. Values of WBC, MCV, MCH and MCHC showed no significant difference (P=.10).

3.3 Serum Biochemistry

Serum biochemistry values of the WAD goats are presented in Table 3. From the results, serum urea, total protein, albumin, SGOT, SGPT and cholesterol values of the various treatments were statistically similar (P=.07) and showed no specific pattern. Globulin values varied significantly (P=.02) and were highest for T6 and T5, followed by T3 and T4 and lowest for T2 and T1 with the higher values corresponding with higher MOBYS intake. Creatinine values were highest for the PTTRS fed goats and also significantly higher (P=.04) than those of RS fed goats, a pattern that repeated itself as MOBYS intake increased.

Table 1. Feed efficiency of WAD goats fed fungal treated rice straw supplemented with maize offal: Brewer yeast slurry mixture

Parameter	T1	T2	T3	T4	T5	T6	SEM
Feed intake (Kg)	20.18^{c}	19.06^{c}	26.58^{b}	27.65^{b}	34.70^{a}	35.65^{a}	425.52
Weight gain (Kg)	1.19^{c}	1.17^{c}	1.75^{b}	1.87^{b}	2.37^{a}	2.45^{a}	0.007
Feed efficiency (Kg)	0.059^{c}	0.061^{c}	0.066^{a}	0.068^{a}	0.068^{a}	0.069^{a}	0.003

a,b,c,---- Means on same row with different superscripts vary significantly (P=.05)
T1, T3 and T5 fed MOBYS and untreated rice straw
T2, T4 and T6 fed MOBYS and Pleurotus tuberregium treated rice straw

Table 2. Hematological parameters of WAD goats fed fungal treated rice straw supplemented with maize offal: Brewer yeast slurry mixture

Parameter	T1	T2	T3	T4	T5	T6	SEM
PCV (%)	24.20^{c}	24.80^{c}	26.30^{bc}	27.00^{b}	30.40^{a}	30.80^{a}	1.14
Hb (g/dl)	8.50^{c}	8.52^{c}	9.02^{bc}	9.25^{b}	11.20^{a}	11.40^{a}	0.32
RBC (x 106/ul)	13.10^{c}	13.00^{c}	14.12^{bc}	14.72^{b}	15.80^{ab}	16.20a	0.64
WBC (x 106/ul)	8.10	8.70	8.80	8.60	8.10	8.70	0.46
MCV (fl)	22.85	23.20	23.70	23.80	24.20	24.80	0.84
MCH (pg)	6.93	7.02	7.07	7.10	7.24	7.36	0.21
MCHC (g/dl)	33.10	33.40	32.80	33.50	33.40	33.00	0.56

a,b,c,---- Means on same row with different superscripts vary significantly (P=.05)
T1, T3 and T5 fed MOBYS and untreated rice straw
T2, T4 and T6 fed MOBYS and Pleurotus tuberregium treated rice straw
PCV= Packed Cell Volume; Hb= Haemoglobin; RBC= Red blood cells;
WBC= white blood cells MCV= mean corpuscular volume MCH= mean corpuscular haemoglobin;
MCHC= mean corpuscular haemoglobin concentration

Table 3. Serum biochemical parameters of WAD goats fed fungal treated rice straw supplemented with maize offal: Brewer yeast slurry mixture

Parameter	T1	T2	T3	T4	T5	T6	SEM
Urea (mmol/l)	17.21	17.00	17.30	17.80	17.50	17.60	0.39
Total protein (g/dl)	68.60	68.30	69.10	69.00	70.70	70.80	1.20
Albumin (g/dl)	32.1	32.0	32.0	32.3	32.80	32.90	0.50
Globulin (g/dl)	46.48^{c}	46.28^{c}	46.85^{b}	46.68^{b}	47.88^{a}	47.90^{a}	0.15
SGOT (iu/l)	198.10	198.60	198.60	98.10	198.80	198.9	0.46
SGPT (mg/dl)	47.00	47.20	48.00	47.90	48.00	48.05	0.43
Cholesterol (mg/dl)	95.30	96.10	95.80	96.00	95.60	95.4	0.36
Creatinine (umol/l)	101.20^{c}	103.00^{a}	102.10^{b}	103.20^{a}	102.80^{b}	103.00^{a}	0.40

a,b,c,---- Means on same row with different superscripts vary significantly (P=.05)
T1, T3 and T5 fed MOBYS and untreated rice straw
T2, T4 and T6 fed MOBYS and Pleurotus tuberregium treated rice straw
SGOT= Serum Glutamic Oxaloacetic Transaminase; SGPT= Serum Glutamic Pyruvic Transaminase

4. DISCUSSION

4.1 Feed Efficiency

The feed efficiency values obtained for the goats in this work are lower than those reported by [3] who reported values ranging from 0.088 to 0.146 for Spanish and Tennessee Stiff – legged breeds respectively. The low values reported in this work are however explained by the fact that feed efficiency is affected by many factors including genetics, environment and diet. The improved feed efficiency corresponding with increased *Pleurotus tuber regium* degraded rice straw and maize offal: brewers yeast slurry intakes attests to the advantage of rice straw bioconversion and the maize offal : brewers yeast slurry mixture. Diet has been implicated as one of the factors affecting feed efficiency [1].

4.2 Haematological Profile

The PCV values reported in this work fall within the range reported by other authors in the country [13]; [14]. The significant difference agrees with the works of [15], but disagrees with reports of [16] [17]. The PCV in this study is reasoned to have been a response to the crude protein status of the dietary treatments that were significantly different among them. Lack of significant difference in PCV values had been attributed to marginal differences in crude protein content of diets [18], while significant differences in PCV values were attributed to variation in crude protein levels of the diets [11]. In this study, the dietary crude protein level varied from 15.72 % (T1) to 21.62 % (T6) and is believed to be responsible for significant variation in PCV values. PCV is beneficial in assessing the protein status and possibly forecasting the degree of protein supplementation in goats [5].

The Hb result of this study agrees with works of [15] but disagrees with that of [19]. This Hb result is attributed to the protein content of the dietary treatments. Low Hb values usually connote nutritional anaemia [14]. In this study the nutrient status of the dietary treatments were high, thus eliminating possibility of nutritional anaemia, and giving credence to the significantly different Hb values for the different dietary treatments. It also implies that with these haemoglobin values, enough oxygen would be transported to tissues of the animals for oxidation of ingested food so as to release energy for body functions and transport carbon dioxide out of the body [20].

The mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration showed an increasing trend from T1 to T6. This is reasoned to be one of the contributory factors to the general feed efficiency trend where better values were obtained progressively from T1 to T6. It also means that the blood condition of the animals was enhanced across the treatments because mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration indicate blood levels; a lower level indicating anaemia [21].

The RBC result agrees with works of [13] and [17] but contradicts that of [22] and [19]. The significant difference observed here in is reasoned to be related to the crude protein levels of the dietary treatments. RBCs are the hemoglobin (iron-protein compound) containing cells of blood [23]. The pattern of significance relates closely to the crude protein levels of the dietary treatments. The import of these RBC values is that the haemoglobin would have reacted with oxygen carried in the blood to ensure tissue supply of oxygen as well as removal of carbon dioxide [24,25].

The WBC non significance agrees with works of [13] and [19] but contradicts those of [18] and [15]. The non significance of WBC is reasoned to be caused by ability of the dietary treatments to confer similar body immunity against diseases. Similarity in WBC may imply conferment with similar immunity since WBC is known to fight disease; WAD goats seem to possess protective system, providing a rapid and potent defence against infectious agents and this is probably the physiological adaptation of the species in zones characterised by disease prevalence [5]. The pattern of similarity and high WBC values is noted to be meaningful due to the fact that the animals with low WBC are exposed to high risk of disease infection while those with high counts are capable of generating antibodies in the process of phagocytosis and have high degree of resistance to disease [26].

The MCV values recorded in this study agree both in range and non significance with earlier report by [13], but contradict report of [19]. The normal and similar values go to buttress the assertion that the animals may neither stand the risk of haemoconcentration nor anaemia [27]. This is supported by adequacy of the nutrient contents of the dietary treatments as well as nutrient intake by the experimental animals.

4.3 Serum Biochemistry

The urea values reported in this work agree with works of [17], [19] and [14]. The normal range in urea values and non significance is reasoned to be due to sufficiency of protein quality fed the experimental animals. Higher values of urea (above reference range) could be attributed to an imbalance in amino acids, indicating that the diet had lower biological value. Increased catabolism of amino acids when protein of lower biological value is fed is responsible for high urea values [5].

Total protein values herein agree with results of [13], [14] and [28] but disagree with results of [15]. High values of TP have been noted to be suggestive of high protein quality of the diet and health status of the animals [29]; [14]. Since the diets provided suitable nutrients in quantity and quality, it is reasoned that the similarity in total protein values is normal. Additionally, total protein values could be constant at a fairly large range of dietary protein [14].

Albumin values reported in this work agree with reports of [13], [14] and [28]. A significant effect of location and high tannin content feeds on ALB of WAD goats was reported [13]; [17]. In this study, the experimental animals were kept in same location and also high tannin was not in the experimental diets. The Globulin values showed a significant difference as was earlier reported by [15] and [18] and [17]. The report however contradicts that of [13] and [19]. The significantly different globulin values are however of no consequence because they all fall within the reference range and imply that their primary role as plasma proteins in maintaining homeostasis in the animals was well carried out [30].

SGOT values in this work are in agreement with work of [17]. It is reasoned that the experimental diets contained no intrinsic factor that could have caused a serious challenge to the heart and/or liver to make elevated SGOT quantity to be detected in the blood. SGOT is an enzyme that is usually present in the liver and heart cells and is released into the blood when the liver or heart is damaged [31].

The SGPT values also agree with works of [32] and [19]. The SGPT values are reasoned to be so because of absence of any serious challenge to the heart or liver, or excess dietary protein. Blood SGPT levels are elevated with damage to liver or heart, or by some medications [31]; higher levels of SGPT may be due to the fact that higher values of the enzyme are required to contend with the high dietary protein content of the diet [20].

Cholesterol result herein is in agreement with works of [17], [19] and [28]. The cholesterol values all fall within the reference range and are thus expected to be beneficial to the animal. Blood cholesterol is not affected by feeding system; it shows an increasing trend after puberty [33]. It is also reasoned that with these cholesterol values, the animals would not face the risk of myocardial infractions usually associated with high blood cholesterol content and emaciation due to low serum cholesterol [34].

The creatinine showed significantly different values for the dietary treatments. However, all the values fell within the reference range. The significant effect reported herein disagrees with other workers [13]; [19]; [28]. These creatinine values, however, mean an absence of any factor in the feed to portray its poor quality and also negatively affect the stability and normal working of the kidney. Serum creatinine level is a useful indicator of glomerular filtration in the kidney; normal values indicate animals are not in a catabolism situation and kidney function is improved. Consequently, the animal is in good nutritional condition [5].

5. IMPLICATIONS OF THE STUDY

Results of the study imply that goats can be kept in confinement and fed with *Pleurotus tuber regium* biodegraded rice straw and maize offal: brewer yeast slurry mixture only, without other forages, especially during the dry season when scarcity of goat feeds is experienced in tropical countries.

6. APPLICATIONS OF THE STUDY

The procedures and results of the study can be easily leveraged upon by other researchers and ruminant farmers.

7. LIMITATIONS OF THE STUDY

Limitations of the study lie in the need for equipment, precision and accuracy of the bioconversion which may not be easily acquired by local farmers themselves and also the fluid nature of the Brewer Yeast Slurry necessitating

either direct drying or the use of carrier substances

8. CONCLUSION

It was concluded that feeding the test inputs at increasing levels improved the feed efficiency, haematological and serum biochemical parameters of the West African Dwarf goats.

9. RECOMMENDATION

It was recommended that the feed formulae evaluated in the present research be adopted by goat farmers as they would be valuable for overcoming feed or forage shortage, especially during dry season.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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