M.Sc. RESEARCH PROJECT

ON

EVALUATION OF EFFECT OF FEED RESTRICTION ON PHYSIOLOGICAL PARAMETERS AND PERFORMANCE IN GROWING WEST AFRICAN DWARF GOAT

BY

OWOOJUONA, OMOTAYO MARY

(20PGAC000089)

DEPARTMENT OF ANIMAL SCIENCE

COLLEGE OF AGRICULTURAL SCIENCE

LANDMARK UNIVERSITY

OMU-ARAN KWARA STATE, NIGERIA.

JULY 2022.

EVALUATION OF EFFECT OF FEED RESTRICTION ON PHYSIOLOGICAL PARAMETERS AND PERFORMANCE IN GROWING WEST AFRICAN DWARF GOAT

BY

OWOOJUONA, OMOTAYO MARY

(20PGAC000089)

A MINI-DISSERTATION SUBMITTED TO THE DEPARTMENT OF ANIMAL SCIENCES COLLEGE OF AGRICULTURAL SCIENCES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURE (ANIMAL SCIENCE).

JULY 2022.

DECLARATION

I Omotayo Mary Owoojuona an M.Sc. student in the Department of Animal Science Landmark University, Omu-Aran, hereby declare that this research project entitled ‘Evaluation of effect of feed restriction on physiological parameters and performance in growing West African Dwarf goat’ is my own work, and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references, and that this work has not been submitted before for any other degree at any other institution.

OWOOJUONA, OMOTAYO MARY 20PGAC000089

…………………………………………………………

DATE & SIGNATURE

The above statement declaration is confirmed by

PROF. E.O OYAWOYE

…………………………………………….

DATE & SIGNATURE

CERTIFICATION

This is to certify that Miss Omotayo Mary Owoojuona with the matriculation number of 20PGAC000089 carried out a research work with the title Evaluation of effect of feed restriction on physiological parameters and performance in growing West African Dwarf goat under the supervision of PROF. E.O OYAWOYE and co-supervisor DR. S.O OLAWOYE and this research work has not been previously submitted for the award of any degree in this or any other university.

……………………………….. …………………

PROF. E.O OYAWOYE DATE

(Supervisor)

…………………………………….. .. …………………

DR. S.O OLAWOYE

(Co- Supervisor) DATE

……………………………………… …………………..

DR. ARUNA ADEKIYA DATE

(Head of Department)

……………………………………….. ……………………….

(External Examiner) DATE

DEDICATION

I dedicate this mini- dissertation to God Most High, who has been my help since inception, who saw me through the beginning down to the final stage of this work. God alone be praised. I also dedicate this project to my parents, Rev. and Evang Mrs. Seyi Owoojuona who stood by me in prayers, support and encouragement.

ACKNOWLEGEMENT

God almighty alone deserves all the glory honor and all the praise for without him this project could not have become a reality.

This mini-dissertation is as a result of the tireless work pursuit of my supervisor PROF. E.O OYAWOYE Thank you for your positive criticism, guidance and mentoring. Thank you for putting your time and commitments into this study. God bless you abundantly Sir.

I also appreciate DR. S.O OLAWOYE, my Co-supervisor for his contributions, supports, suggestions, corrections, time and effort towards making the project successful. God bless you Sir.

I also express my appreciation to my family for their love, support and guidance throughout my studies. I also express my gratitude to my friends who helped where they could, God bless you all. Furthermore, I also express my gratitude to the Lecturers of the Department of Animal Science; Dr. O.O. Alabi, Dr. B.T Adesina, Dr. A.J. Shoyombo, Dr. Rasaq Animashahun, Dr F.A Okeniyi, Dr. O. M. Mavis, Dr. R.C. Okocha and Mr. M.B. Falana, who gave me productive suggestions and ideas until the desired results were met. A big thank you to Mr. Ekemini for his vital contributions.

Table of Contents

ABSTRACT

Feed restriction limits food availability for growth and output while also altering energy metabolism. Long-term feed restriction has been shown to reduce animal body weight gain, hemoglobin concentration, pack cell volume (PCV), and erythrocyte count. With scarcity of food, many animals develop adaptive biochemical and physiological responses.

Twenty-four WAD goat kids (ages between 5 and 6 months) with similar weight were randomly divided into four treatments (T1, T2, T3, and T4). Treatment 1 represent 100% *ad libitum* feeding; T2 (30% feed time restriction and 70% *ad libitum* feeding); T3 (50% feed time restriction and 50% *ad libitum* feeding) and T4 (70% feed time restriction and 30% *ad libitum* feeding). The experiment was laid in a complete randomized experimental design. The animals were fed on a diet composed of a mixture of dried cassava peel (60%) supplemented with *Gliricidia sepium* (40%) Treatment 1, which was 100%, was fed dried cassava peel and *Gliricidia sepium ad libitum* for 10 hours without restriction. Treatment 2, which was 70% was fed dried cassava peel and *Gliricidia sepium ad libitum* for 7 hours and was restricted for 3 hours. Treatment 3, which was 50%, was fed dried cassava peel and *Gliricidia sepium ad libitum* for 5 hours and was restricted for 5 hours, and Treatment 4, which was 30%, was fed dried cassava peel and *Gliricidia sepium ad libitum* for 3 hours and was restricted for 7 hours. Data collected on feed intake, water intake, weight gained, temperature, heamatology, biochemical indices and carcass quality were analyzed using SAS (2010 package).

The highest result for weekly feed intake was obtained in T1 without restriction (2.07±0.67). Across the treatments, animals in T1 had the highest values of water intake all through the 10 weeks compared to other treatments. The highest weekly weight gain was noticed in WAD goats fed in T1. Values for PCV for animals fed for10 hours, 7 hours and 3hours were all within the acceptable range of 22-38% (29.00±0.58), (23.33±0.88), (21.00±0.00). White blood cell counts, red blood cell counts, haemoglobin, and mean corpuscular volume values in all treatments were all within the recommended range of (4-13 $X10^{9}$/L), (8-18 $X10^{12}$/L), (8-12 g/L) and (30-36 g/dl) for healthy goats. Values for total protein ranged from (26.00±1.73) to (33.00±1.15) for animals fed at 30% and 100%, respectively. This study concludes that feed restrictions in terms of time allowed for feeding affected physiological performance and biochemical indices of WAD goats. It is there by recommended that WAD goats should at least be allowed a minimum of 50% to good feeding per day.

Keywords: Growing West African dwarf goats; feed time restriction; Physiological performance; Biochemical indices and Heamatology

List of Figures

List of Tables

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to study

Feed restriction limits food availability for growth and output while also altering energy metabolism (Hill *et al*., 2019). This has an impact on the lipid-to-protein deposition ratio and, as a result, on body composition (Strydom *et al.*, 2019). Most importantly livestock management is appropriate nutrition; nevertheless, insufficient feeding, both in quantity and quality, contributes to low livestock output in the tropics (Balehegn *et al.,* 2020). Furthermore, long-term feed restriction has been shown to reduce body weight gains (Cienfuegos *et al.*, 2020), hemoglobin concentration, pack cell volume, and erythrocytes number (de Carvalho *et al.*, 2019). In ruminants, limited feed and water intake have been found to affect packed cell capacity. Feed limitation, according to (Fischer *et al.*, 2020), reduces whole-body oxygen use and heat output. Adapting to low energy intakes is thought to be critical for animal survival at times when feed sources are sparse (Desforges *et al*., 2021).

Ruminants in Nigeria eat only natural pastures, according to (Na-Allah & Akoh, 2020), during the wet season, natural pastures are sufficient for maintenance and weight gain, but during the dry season, the opposite is true. Since pastures are not available at all times of the year (Boddey *et al.*, 2020). As a result, ruminant animals will be unable to achieve their nutrient requirements for maintenance on natural grass alone (Masters *et al.*, 2019). As a result, an animal's weight may increase when the weather is wet because the amount of rainfall increases, while when the weather is dry, the amount of rainfall decreases (de Carvalho *et al*., 2019). Animal's ability to tolerate a lack of food is extremely valuable, especially during the dry season or in a dry climate. (de Carvalho *et al*., 2019) described the problem of poor nutrition of the animals, dry season feed, and feeding as a limiting issue to a successful ruminant production operation in Nigeria, resulting in a reduction of growth, work, upkeep, production, and reproduction of animals. Most farmers give nutritious materials such as PKC, *Gliricidia* sepium, and Elephant grass, among other things, to support growth during the dry season. When faced with a scarcity of food, many animals develop adaptive biochemical and physiological responses. Goats live in areas where food is scarce or interactions with suitable food sources are rare. As a result, the goal of this study is to see how restricted feeding affects some physiological characteristics and performance in growing West African dwarf goats.

West African Dwarf (WAD) goats live in the humid coastal region of West Africa, south of latitude 140N, with a high prevalence of illnesses (Daramola & Adeloye, 2009). They are normally given the freedom to find their food. Goats are extensively reared at the subsistence level in Nigeria and West Africa as a whole, and these animals feed for themselves without any deliberate effort by man to supplement or improve their plane of nutrition, whereas intensively reared goats are housed and given medication with improved nutrition, while the semi-intensive system of management represents a varying degree of compromise between the two management systems stated above. Goats are voracious feeders, yet they are prone to ingesting foreign bodies in difficult environments. The ability to flourish in difficult weather conditions is an attribute that makes goat husbandry a successful endeavor, according to (Akinrinmade & Akinrinde, 2012)

Water is required for all of the body's basic physiological activities. Water is needed in significantly higher quantities than other nutrients, and its availability and quality are crucial for animal production and health. According to (Ghanem *et al.,* 2008), water deprivation affects an animal's physiological balance, causing weight loss, low reproduction rates, and illness resistance.The amount of water required by goats is determined by their requirements for maintaining a proper equilibrium of water and achieving sufficient output levels. The usual water content of a goat's body varies with age, body fat, and external temperatures (Wani, 2010). Goats should always have access to clean and fresh water most time. A positive relationship exists between the amount of dry matter consumed and the amount of water consumed has been reported by (Araújo *et al.*, 2010). According to (Kumaravel, 2020), goats are among the most water-efficient domestic animals, with a per pound of body weight water turnover rate comparable to camels.

1.2 Statement of problem

The environment in which an animal finds itself determines its performance. (De Carvalho *et al*., (2019) highlighted dry season feed and feeding as a limiting factor to a successful ruminant production operation in Nigeria due to inadequate animal nutrition, which typically causes a decline in growth, work, upkeep, production, and reproduction of animals. Most farmers give nutritious materials such as PKC, *Gliricidia sepium*, and Elephant grass, among other things, to support growth during the dry season. There are, however, few reports on ruminant physiological function during and after short-term feed shortage. When faced with a scarcity of food, many animals develop adaptive biochemical and physiological responses. Goats live in areas where food is scarce or interactions with suitable food sources are rare.

The majority of peasant farmers in rural areas have limited access to financing and incentives that would encourage them to utilize concentrates to help their goats develop during the dry season. As a result, farmers should be aware of the consequences of protracted periods of starvation, particularly during the dry season and on the way out.

1.3 Justification of the research

Feed availability, cell multiplication, cell size increase, and the accumulation of extracellular chemicals over time all influence body growth (Prasad *et al.*, 2019). This is a regular occurrence as a result of a well-balanced and timely ration feed. This pattern is based on a methodical technique that looks for a typical growth pattern and a satisfactory animal body condition score. As a result, the animal's feed and water intake may be altered, and the body's growth pattern may become uneven, with delayed, unbalanced development. Due to the inconsistency of balanced ration availability, reproductive ability may be harmed.

1.4 General objective of the research

The major goal of this study is to examine how feed restriction affects the performance of growing WAD goat kids, including some physiological adaptations to feed deprivation.

1.5 Specific objectives of the research:

The specific objective of this study is to evaluate the effect of feed restriction on;

- Feed intake, water intake, and their utilization
- Growth performance of WAD goats
- Hematology and biochemical indices
- Carcass quality

CHAPTER TWO

2.0 LITERATURE REVIEW

For livestock production, good nutrition is essential. Goats eat a wide variety of foods, preferring plant leaves, seeds, and cellulose, for example, roughages as well as meadows (Kubkomawa, 2019). Natural pastures are the main source of food for animals in the tropics, despite the fact that during the dry seasons they are fibrous, lignified, and low in protein diet. (de Moura *et al.,* 2021).

Goats are finicky browsers, preferring a variety of feed vegetation kinds (Mansoor & Fadlalla, 2021). Their grazing habits let them thrive in semi-arid environments better than sheep or cattle (Dias-Silva and Abdalla, 2020). They eat a lot of dry stuff, about 3% -5% of their total weight to stay alive in settings that are not ideal (Flay *et al.,* 2021). They respond favorably to increases in feed quality and quantity (Goetsch, 2019), except in high-volume production, where Infestations of parasites are possible and have the widest range of adaptation and tolerance to many illnesses (Sejian *et al.,* 2021).

2.1 Feed restriction on goat

Differences in energy requirements and digestive efficiency, depending on the efficiency of gross energy usage for production, are crucial factors in deciding which animal to raise in situations with insufficient natural resources, limited food supplies, and low quality food (Devendra, 1990). Goats are a wonderful choice for animal production in these challenging circumstances due to their increased flexibility and resistance, smaller body size, high digestive efficiency, and capacity to slow down their metabolism (Silanikove, 2000). In this regard, feed restriction is a common occurrence for goats in global production systems, both quantitatively and qualitatively, necessitating research that identify and explain how animals react in these circumstances. Additionally, ruminants, such as sheep and goats, are raised widely in these underdeveloped areas, raising concerns about the production of greenhouse gases. The primary determinants of ruminant methane generation are diet content and ingestion (Archimede *et al.*, 2011; Hristov *et al.*, 2013); therefore, methods like providing large amounts of grains or delivering various amounts of feed have been studied in cattle and sheep. On the other hand, as variations in diet, species, genotype, and habitat, among other things, can have a significant impact on the microbial community composition in the rumen (Janssen and Kirs, 2008)

2.2 Nutrient requirements of goats

Nutrients are necessary for the goats' upkeep, growth, reproduction, pregnancy, and production of meat, milk, and hair.. Goat nutrition includes energy, protein, and their ratios, as well as minerals, vitamins, and water. Farm animals require a lot of energy to survive. Also, in dairy cows, a lack of energy results in a loss in production right away, and over time, other symptoms such as stunted growth, delayed puberty, and decreased fertility will become apparent (Pinotti *et al*., 2019).

Throughout life, Proteins are necessary for bodily development and repair as well as the synthesis of hormones, enzymes, milk, and hair. Unlike monogastric, Amino acids taken from the small intestine mostly satisfy ruminants' protein needs. These amino acids, however, come from dietary (post-ruminal) and microbiological sources (soluble protein, non-protein nitrogen, and ruminal ammonia) (Hou *et al*., 2019).

2.3 Feed intake of goats

Feeding voluntarily is described as the quantity of food an animal or a group of animals consumes when they have free access to food, and it is a complex mechanism controlled centrally by several local gastrointestinal reflex arcs (Ahmed, 2021). They are among the most water-efficient domestic animals, with per unit of body weight rate of water turnover approaching that of a camel (Gerken *et al*., 2019). It has been discovered that dry matter intake and water intake have a beneficial association (Ahmed & El-Shafei, 2001).

Feed constraint limits the organism's total amount of oxygen and heat produced (Fletcher *et al.*, 2019). This adaptability to low-energy feed intakes is believed to be critical for animal survival during times when feed sources are short (Wreford *et al*., 2020). The reduced feeding, on the other hand, slows down metabolism (Pellegrini *et al*., 2020); it alters the metabolic consumption of energy and lowers nutritional availability for growth and output (Jha *et al*., 2019). This has an impact on the lipid-to-protein deposition ratio and, as a result, on body composition. Furthermore, long-term feed restriction has been shown to reduce body weight growth (Jamshed *et al*., 2019). Animal ability to tolerate a lack of food is extremely valuable, especially in a hot, dry climate. Few studies look at how ruminants' physiological performance varies during and after short-term feed deprivation. Many animals demonstrate adaptive biochemical and physiological reactions to a shortage of food, which is noteworthy. Goats live in areas where food is scarce or interactions with suitable food sources are rare (Wang *et al.*, 2006).

2.4 Feed restriction on blood parameters in goat

Blood is a vital tool for determining an animal's health status (Babeker & Elmansoury, 2013). Heamatological markers are good indications of an animal's physiological condition (Bezerra *et* *al*., 2017) and can be used to assess animal pathogenic problems (Ariyibi *et al.*, 2002). Animal's heamatological parameters have been said to be influenced by elements like breed, age, sex, nutrition, and climate (Dash *et al.*, 2013; Simsek *et al.*, 2015)

Feed restriction reduces Hb concentration, PCV, and erythrocyte number considerably (Modra *et al*., 2020). In ruminants, limited feed and water intake have been found to affect packed cell capacity (Maurya *et al*., 2020). In goats, hematocrit rises linearly with increasing feed levels in the limitation phase and falls in the re-feeding phase (Ibrahim *et al.*, 2020). Animals' ability to tolerate a lack of food is extremely valuable, especially in a hot, dry climate.

2.5 Cassava crop

Cassava is a bushy perennial shrub with a root that is edible, it originated in South America, and around the sixteenth century, it was brought to Nigeria (Adeniji *et al*., 2005). In contrast, cassava is regarded as a poor man's food. The crop has also been extensively chastised for its productivity depleting soil nutrients and exposing farms to erosion (Hershey *et al*., 2001)

2.5.1 Cassava production in Nigeria

Cassava called *Manihot esculenta* (botanical name) is a perennial woody shrub with an edible root. Cassava has its origin in South America then around the sixteenth century (Adeniji *et al*., 2005). After rice and maize, cassava is the third-most significant source of carbohydrates in the tropics, and is drought-tolerant, allowing it to flourish on marginal soils. Cassava is important not just as a food crop, but also as a source of revenue for rural agricultural people. When compared to other staples, cassava, being a cash crop, provides the most households with cash income, thus, helping to alleviate poverty (FAO, 2005).

Cassava fits well into the farming methods of Nigeria's smallholder farmers as a food crop. This is due to the fact that cassava is available all year, assuring household food security. In comparison to other crops such as grains, drought, pests, and disease resistance are all advantages of cassava. Cassava is also more resistant to poor soil fertility than grains. Furthermore, after reaching maturity, its roots can be preserved in the ground for months. (Ikuemonisan *et al.*, 2020).

2.5.2 Cassava peel production in Nigeria

Cassava peel waste is produced during the manufacturing of farihna, garri, and chikwangue. The biggest concern is inappropriate peel storage for long periods, especially when it rains heavily (Ofuya & Obilor 1993). When making fermented cassava items, the roots are often peeled to remove the two outer coats—a thin brown outer coating and a thicker leathery parenchymatous inner covering. Peels like these are considered waste and are normally thrown away, left to decompose or fed to ruminant animals. Hand peeling can result in peels accounting for 20 to 35 percent of the overall weight of the tuber (Ekundayo, 1980).

2.6 *Gliricidia sepium* Leaf

A medium-sized perennial legume tree, *Gliricidia sepium* grows to a height of 2 to 15 meters. In general, it is deciduous throughout the dry season, however, it is said to remain evergreen in humid places. It is used as decorative, green manure, feed, and firewood tree all over the world. Stem cuttings are easy to clone, but seedlings establish superior roots. Choosing erect, less-forked *Gliricidia* clones as living fences, support trees for peppers and yams, and shade for cocoa and coffee (Brewbaker, 2004).

In the tropics, the use of plants in various forms is increasing as an alternative to the relatively expensive and in-demand conventional feed sources used to produce monogastric animals. This is because these plants and the components of them may be a crucial source of protein, phytobiotics, and antioxidants for monogastric nutrition (Oloruntola *et al.,* 2015; Dhama *et al.,* 2015). Plant phytochemicals boost antioxidant, antimicrobial, feed flavor, and palatability, potentially leading to increased feed intake and animal performance (Valenzuela-Grijalva *et al.*, 2017). Because of their quick development, which is aided by climatic and environmental variables, these tropical plants are available. Their dietary inclusion in the form of meals has the potential to lower commercial feed costs, resulting in lower animal protein costs and improved animal health. (Amata, 2010; Dhama *et al.*, 2015; Oloruntola *et al.*, 2016). *Gliricidia* sepium produces enormous amounts of high-quality biomass throughout the year and contains enough amounts of high-quality protein and minerals (Oloruntola *et al.*, 2016).

Figure 1The west african dwarf goat

CHAPTER THREE

3.0 MATERIALS AND METHOD

3.1 Location of Study

This research was carried out at the Ruminant unit of the Teaching and Research Farm of Landmark University, Omu-Aran. The Teaching and Research Farm lies in the agro-eological region of southern guinea savannah Nigeria. Omu-Aran is stationed on latitude 8° 8′00″ N and longitude 5°6′00″ E, on altitude of 564m above sea level in Kwara State Nigeria (Rapheal *et al.*, 2019).

3.2 Source and Management of Experimental Animals

Twenty four West African Dwarf goat kids ages between 5 and 6 months, similar in weight were sourced from the Landmark University Teaching and Research Farm for the study. The ages of the animals were determined by dentition. The animals were allowed to adjust to the experimental condition for one week before the start of the experiment. They were also treated with Ivermectin, levamisol injection, and oxytetracycline 20% injection. They were housed in a closed shed with sufficient ventilation to allow heat and moisture to escape. Appropriate feeding and watering facilities were provided within the housing system. The animals were caged individually. Water intake (daily), feed intake (daily), body temperature (weekly), and body weight (weekly) were measured. Blood samples were also collected at the end of the experimental period.

3.3 Experimental Procedure and Layout

Experimental WAD goats were randomly divided into four experimental Treatments in a complete randomized experimental layout. Each group of animals was randomly allotted to experimental feed restriction time regime treatments (1, 2, 3, and 4). The animals were fed between hours of 8 am and 6 pm daily (08:00hr – 18:00hr) for Ten weeks depending on the time allotted to each animal group. Treatment 1 (0% feed time restriction; 100% *ad libitum* feeding), Treatment 2 (30% feed time restriction; 70% *ad libitum* feeding), Treatment 3 (50% feed time restriction; 50% *ad libitum* feeding), Treatment 4 (70% feed time restriction, 30% *ad libitum* feeding). Here Treatment 1 was served as the control, as it was allowed daily voluntary feed intake for 10 hours all through the experimental weeks. The four experimental animals groups 1, 2, 3, and 4 were exposed to feed restrictions for 10 weeks according to their feeding time frame. The haematological parameters were determined immediately after blood sampling.

	REP 1	REP 2	REP 3	REP4	REP5	REP6
TREATMENT 1	TA	TB	TD	TC	TD	TA
TREATMENT 2	TB	TA	TC	TD	TA	TB
TREATMENT 3	TC	TD	TB	TA	TB	TC
TREATMENT 4	TD	TC	TA	TB	TC	TD

TA= Treatment A, TB= Treatment B,

TC= Treatment C, TD= Treatment D

3.4 Source of Water and Experimental Diet

The animals were fed on a diet that was comprised of a proportioned mixture of dried cassava peel (60%) and a day wilted *Gliricidia sepium* (40%), in addition to free access to salt lick. The *Gliricidia sepium* was collected fresh and used the following day while dried cassava peels were purchased at Ganmo-Ilorin market in Kwara State. Animals were fed at 5% body weight at ratio 3:2 of cassava peel and *Gliricidia sepium* respectively. Feed were supplied and monitored according to the allotted experimental time. Animal feeds were mixed together. Treatment 1, which was 100%, was fed dried cassava peel and *Gliricidia sepium ad libitum* for 10 hours without restriction. Treatment 2, which was 70% was fed dried cassava peel and *Gliricidia sepium ad libitum* for 7 hours and was restricted for 3 hours. Treatment 3, which was 50%, was fed dried cassava peel and *Gliricidia sepium ad libitum* for 5 hours and was restricted for 5 hours, and Treatment 4, which was 30%, was fed dried cassava peel and *Gliricidia sepium ad libitum* for 3 hours and was restricted for 7 hours. All the treatments were allowed free access to clean fresh water.

3.5 Data Collection

Data collected were the water intake, feed intake, weight gained, temperature, heamatology, serum biochemistry, and carcass quality.

The water intake for each goat was determined using a graduated glass cylinder, and each treatment (100%, 70%, 50%, and 30%) was allowed free access to 500ml of clean fresh water throughout the experiment daily. Animals were fed according to their feed time restriction (100%, 70%, 50%, and 30%). After *ad libitum* feeding daily, the remaining feed was weighed using a measuring scale. The goat kids were weighed to the closest ±0.5 kg using a typical hang balance (Pocket balance) at the end of every week all through the experimental week. Using a digital thermometer, the temperature of experimental animals was measured at the same time at the end of every week to the nearest ±0.1°C. Blood samples were collected via jugular venipuncture with plastic disposable syringes. Samples of 2ml of blood were collected in clean EDTA (anticoagulant) treated tubes for heamatological studies and 2ml of blood was collected in a plain bottle without anticoagulant for serum biochemistry, there after the samples were sent to the laboratory for heamatological analysis. The packed cell volume (PCV) was determined using a microhematocrit centrifuge (Hettich- Germany). The concentration of heamoglobin (Hb) was determined using the cyano methaemoglobin technique, as described by (Yousif, 2019). The total erythrocytes count was performed in an improved Neubauer-haemocytometer (Fazio, 2019). At the end of the experiment, animals were slaughtered for carcass analysis by sacrificing the animals. After sacrificing, the animals were carried to the animal science laboratory at Landmark University where the analysis was performed. The animals were skinned using a new sharp blade, after skinning the animals, animals were dressed and the dressed carcass was weighed. The animals were dissected where the head, legs, intestine, kidney, heart, liver, lungs, spleen, and skin were weighed respectively.

Proximate analysis was carried out on feed (dried cassava peel and wilted *gliricidia sepium*) used for the experiment to determine the proximate composition of moisture content, crude protein, crude fibre, ether extract, ash, NDF (Neutral detergent fibre), ADF (Acid detergent fibre), and ADL (Acid detergent lignin).

3.6 Statistical analysis

The experimental data were analysed statistically using the analysis of variance (ANOVA) model to establish the degree of significance ($P<0.05$) between different treatments. The analysis was carried out using SAS (2010 package). The treatment means were compared using the Duncan Multiple Range Test (DMRT) at 0.05 level of probability

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

The proximate compositions of the feed materials used in this study are wilted *Gliricidia sepium* and dried cassava peels presented in Table 4.1 below.

A leguminous tree called *Gliricidia sepium* produces tasty protein in its leaves (approximately 18-23% crude protein) (Sulendre *et al.,* 2021). Due to a variety of palatability difficulties, fresh *Gliricidia* leaf is only occasionally used by ruminant animals (Sulendre *et al.,* 2021). One strategy to increase its acceptance and utilization is to turn it into meal or pellets and combine it with other regional components.

In ruminant feed, cassava peels serves as a source of energy which plays an appropriate role as basal diet or supplement. The presence of hydrocyanic acid makes fresh cassava peel difficult to feed the animals, dry, ensiling and fermented cassava peel are used to reduce the concentration level of the acid when feeding the animals which make it save to the animals According to (Ologun, 2004).

A major strategy for enhancing ruminant animals' capacity for growth is to create diets rich in ME and CP. Dried cassava peel is very high in ME content (12.4 MJ ME/kg DM) and extremely low in CP (1-3%) (Heuze *et al.,* 2016a). Because it is high in ME, which could provide ruminant animals with energy, but low in CP, dried cassava peel has potential as a supplement in the fattening process. A tropical tree legume with high amounts of CP*, Gliricidia sepium* is abundantly available (22.4%) and relatively low in ME (11.5 MJ ME/kg DM), (Marsetyo *et al.*, 2012). In this climate, dried cassava peels and *Gliricidia sepium* are both comparably inexpensive feed materials, and combining these two easily accessible resources would allow for the creation of a diet high in ME and sufficient in CP with the intention of fostering economic gain.

In this study *Gliricidia sepium* was used as protein supplement to dried cassava peel. A summary of the proximate composition is shown in Table 4.1 below.

Table 4.1 proximate composition of ingredients

	Gliricidia sepium	Dried cassava peels
CP%	22.4	2.78
ME (MJ ME/kg DM)	11.5	12.2
CF%	18.83	6.06
EE%	16.93	2.17
ASH%	31.00	8.50
MOISTURE%	10.83	13.00
NDF%	38.83	16.67
ADF%	29.25	16.00
ADL%	6.64	13.50

Legend: GLI = *Gliricidia sepium*, CAS = Dried cassava peel, EE = Ether Extract, CP = Crude Protein, CF = Crude Fibre, NDF= Neutral detergent fibre, ADF= Acid detergent fibre, ADL= Acid detergent lignin, ME= Metaboliaeble Energy

Table 4.2 shows the water intake of WAD goats fed at a different level of feed time restriction. Water intake in T1 (100%), T2 (70%), T3 (50%), and T4 (30%) were not significantly different ($p<0.05$) in week 1, meanwhile T1 (100%) had the highest water intake. In week 2, there was no significant difference ($p<0.05$) between T3 (50%) and T4 (30%). However, they were significantly ($p<0.05$) different from T1 (100%) and T2 (70%). In addition, the result for week 3 indicates that there was no significant difference ($p<0.05$) between T1 (100%) and T2 (70%). But they were significantly different ($p<0.05$) from T3 (50%) and T4 (30%).

The result for water intake in week 4 were all significantly similar ($p<0.05$) except for T1 (100%). In week 5, T1 (100%) and T2 (70%) had no significant difference ($p<0.05$) but were significantly different ($p<0.05$) from T3 (50%) and T4 (30%). The result for week 8 indicates that there was no significant difference ($p<0.05$) between T1 (100%) and T2 (70%). But they were significantly different ($p<0.05$) from T3 (50%) and T4 (30%). Furthermore, week 9 indicates that there was no significant difference ($p<0.05$) between T2 (70%), T3 (50%), and T4 (30%). But they were significantly different ($p<0.05$) from T1 (100%). For week 10, there was no significant difference ($p<0.05$) between T3 (50%) and T4 (30%). However, T3 (50%) and T4 (30%) were significantly different ($p<0.05$) from T1 (100%) and T2 (70%).

Values for T1 ranged from 326.00±12.12 (week 4) to 383.67±8.76 (week 10). For T2, the lowest value of water intake was obtained at week 4 (272.00±8.66) while the highest value of water intake was obtained at week 5 (351.00±2.08). For T3, the lowest value of water intake was obtained at week 4 (254.00±13.00) while the highest value of water intake was obtained at week 7 (313.00±13.45). For T4, the lowest value of water intake was obtained at week 3 (239.00±10.54) while the highest value of water intake was obtained at week 9 (262.33±6.23).

In general, the highest result for weekly water intake for T1 was obtained in the order of week 10 (383.67±8.76) followed by week 2 (372.67±25.83), then week 9 (363.67±8.76). For T2, the highest result for weekly water intake was obtained during week 5 (351.00±2.08), followed by week 3 (324.00±3.06), week 2 (323.33±12.13), week 6 (316.67±7.69), and week 10 (313.33±33.35). For T3, the highest result for weekly water intake was obtained during week 7 (313.00±13.45), followed by week 6 (312.33±4.91), and week 5 (309.67±9.17). For T4, the highest result for weekly water intake was obtained during week 9 (262.33±6.23), followed by week 2 (259.00±11.37) and week 8 (258.00±8.50). Across the treatments, animals in T1 had the highest values of water intake all through the 10 weeks compared to other treatments. A summary of the result is shown in Table 4.2

Table 4.2 Least square mean **(**±SE) for water intake (ml) of the animals fed at different feed-time restrictions

	T1 (100%)	**T2 (70%)**	**T3 (50%)**	**T4 (30%)**
Week 1	330.67±9.82^{a}	276.67±23.35^{a}	267.67±13.93^{a}	243.00±15.63^{a}
Week 2	372.67±25.83^{b}	323.33±12.13^{ab}	288.00±28.35^{a}	259.00±11.57^{a}
Week 3	336.00±1.53^{c}	324.00±3.06^{c}	291.33±3.18^{b}	239.00±10.54^{a}
Week 4	326.00±12.12^{b}	272.00±8.66^{a}	254.00±13.00^{a}	250.33±10.99^{a}
Week 5	358.00±3.00^{c}	351.00±2.08^{c}	309.67±9.17^{b}	243.67±3.48^{a}
Week 6	344.67±11.55^{c}	316.67±7.69^{bc}	312.33±4.91^{b}	249.00±11.53^{a}
Week 7	347.33±10.90^{c}	292.67±7.33^{b}	313.00±13.45^{b}	253.00±9.30^{a}
Week 8	358.00±6.66^{b}	282.00±7.09^{b}	278.33±42.06^{a}	258.00±8.50^{a}
Week 9	363.67±8.76^{b}	275.67±2.91^{a}	255.00±37.53^{a}	262.33±6.23^{a}
Week 10	383.67±8.76^{b}	313.3±33.35^{ab}	266.33±38.77^{a}	255.00±16.44^{a}

abc =The means within the same row with different superscripts are statistically ($p<0.05$) different

Legend

T1 (Animals that ate for 10 hours without feed restriction)

T2 (Animals that ate for 7 hours with 3 hours feed restriction)

T3 (Animals that ate for 5 hours with 5 hours feed restriction)

T4 (Animals that ate for 3 hours with 7 hours feed restriction)

Table 4.3 shows the summary of feed intake fed throughout the experimental week. The result of the feed intake of the animals showed that there was no significant difference ($p<0.05$) between T1 (100%), T2 (70%), T3 (50%), and T4 (30%) for week 1 and week 2, they were all significantly ($p<0.05$) similar but T2 (70%) had the highest feed intake in week 1 and week 2. In week 3, T1 (100%) and T2 (100%) were significantly similar ($p<0.05$). However, they were significantly ($p<0.05$) different from T3 (50%) and T4 (30%). Furthermore, the results for weeks 4, 5, 6, 7, 8, and 9 indicate that there was no significant difference ($p<0.05$) between T3 (50%) and T4 (30%). Also, T1 (100%) and T2 (70%) were significantly similar ($p<0.05$) during the weeks aforementioned.

Values for feed intake for T1 ranged from 1.33±0.12 (week 1) to 2.07±0.67 (week 10). For T2, the lowest value of feed intake by the animals was obtained during week 4 (1.40±0.58) while the highest value of feed intake was obtained during weeks 7 and 8 at 1.90±0.00 and 1.90±0.06 respectively. For T3, the lowest value of feed intake was obtained at week 3 (1.27±0.33) while the highest value of feed intake was obtained during weeks 8, 9, and 10 (1.47±0.07, 1.47±0.12, 1.47±0.07 respectively). For T4, the lowest value of feed intake was obtained at week 9 (1.23±0.33) while the highest value of feed intake was obtained at week 4 (1.43±0.03).

Generally, the highest result for weekly feed intake for T1 was obtained in the order of week 10 (2.07±0.67) followed by week 7 (2.03±0.88), then week 5 (2.00±0.00). For T2, the highest result for weekly feed intake was obtained during week 7 (1.90±0.00) and week 8 (1.90±0.06), followed by both week 3 and week 6 (1.83±0.33). For T3, the highest result for weekly feed intake was obtained during week 8 (1.47±0.07), week 9 (1.47±0.12), and week 10 (1.47±0.07), followed by week 2 (1.43±0.33). For T4, the highest result for weekly feed intake was obtained during week 1 (1.40±0.10), week 3 (1.40±0.58), week 7 (1.40±0.06), and week 10 (1.40±0.06).

Although at the beginning of the experiment (week 1), T1 had the lowest value of feed intake compared to other treatments. However, the weekly feed intake of the animals from week 3 to week 10 was the highest for T1 compared to other treatments. A summary of the result is presented in Table 4.3

Table4.2 Least square mean **(**±SE) for feed intake of the animals fed at different feed-time restrictions

	T1 (100%)	**T2 (70%)**	**T3 (50%)**	**T4 (30%)**
Week 1	$1.33±0.12^{a}$	$1.40±0.58^{a}$	$1.40±0.12^{a}$	$1.40±0.10^{a}$
Week 2	$1.60±0.25^{a}$	$1.67±0.33^{a}$	$1.43±0.33^{ab}$	$1.27±0.67^{a}$
Week 3	$1.90±0.00^{c}$	$1.83±0.33^{c}$	$1.27±0.33^{b}$	$1.40±0.58^{a}$
Week 4	$1.80±0.58^{b}$	$1.70±0.58^{b}$	$1.36±0.12^{a}$	$1.43±0.03^{a}$
Week 5	$2.00±0.00^{b}$	$1.80±0.58^{b}$	$1.40±0.12^{a}$	$1.30±0.00^{a}$
Week 6	$1.93±0.33^{b}$	$1.83±0.33^{b}$	$1.40±0.12^{a}$	$1.26±0.33^{a}$
Week 7	$2.03±0.88^{b}$	$1.90±0.00^{b}$	$1.43±0.13^{a}$	$1.40±0.06^{a}$
Week 8	$1.97±0.33^{b}$	$1.90±0.06^{b}$	$1.47±0.07^{a}$	$1.30±0.12^{a}$
Week 9	$1.90±0.06^{b}$	$1.40±0.58^{b}$	$1.47±0.12^{a}$	$1.23±0.33^{a}$
Week 10	$2.07±0.67^{c}$	$1.80±0.00^{b}$	$1.47±0.07^{a}$	$1.40±0.06^{a}$

abc =The means within the same row with different superscripts are statistically ($p<0.05$) different

Legend

T1 (Animals that ate for 10 hours without feed restriction)

T2 (Animals that ate for 7 hours with 3 hours feed restriction)

T3 (Animals that ate for 5 hours with 5 hours feed restriction)

T4 (Animals that ate for 3 hours with 7 hours feed restriction)

Table 4.4 shows the weekly weight gain of the animals had no significant difference ($p<0.05$) between T1 (100%), T2 (70%), but there was a significant difference ($p<0.05$) in T3 (50%) and T4 (30%) for week 1 and week 2. Moreover, the result for week 4 indicates that all the treatments were significantly different ($p<0.05$) T1 (100%), T2 (70%), T3 (50%), and T4 (30%), but in week 5 they were significantly ($p<0.05$) similar but T1 (100%) had the highest weekly weight gain. For weeks 6 and 7, the results for T1 (100%), T2 (70%), and T3 (50%) were significantly ($p<0.05$) similar but was significantly ($p<0.05$) different in T4 (30%). Furthermore, week 9 and week 10 were significantly ($p<0.05$) similar in T1 (100%) and T2 (70%) but they were significantly ($p<0.05$) different from T3 (50%) and T4 (30%).

The result for the weekly weight gain of animals for T1 ranged from 6.33±0.33 (week 1) to 7.70±0.23 (week 10). For T2, the result for the weekly weight gain of the animals ranged from 5.57±0.19 (week 8) to 6.90±0.56 (week 10). For T3, the lowest value of weekly weight gain was obtained in week 4 (4.00±0.31) while the highest value of weekly weight gain was obtained during week 10 (6.10±0.21). The results for T4 showed that 3.93±0.32 was the lowest value of weekly weight gain obtained at week 3 while 4.70±0.58was the highest value of weight gain obtained at week 10.

Generally, the highest result for weekly weight gain for T1 was obtained in the order of week 10 (7.70±0.23) followed by week 9 (6.90±0.25), then week 6 (6.73±0.33). For T2, the highest result for weekly weight gain was obtained during week 10 (6.90±0.56), followed by week 9 (6.80±0.61), week 1 (6.33±0.33), and week 6. For T3, the highest result for weekly weight gain was obtained during week 10 (6.10±0.21), followed by week 1 (6.00±0.00), and week 8 (5.83±0.88). For T4, the highest result for weekly weight gain was obtained during week 1

(5.00±0.58), followed by week 5 (5.44±0.37) and week 10 (4.70±0.58). A summary of the result is presented in Table 4.4

Table 4.3 Least square mean (±SE) for weekly weight (kg) gain of the animals fed at different feed-time restrictions

	T1 (100%)	**T2 (70%)**	**T3 (50%)**	**T4 (30%)**
Week 1	$6.33{\pm}0.33^{b}$	$6.33{\pm}0.33^{b}$	$6.00{\pm}0.00^{ab}$	$5.00{\pm}0.58^{a}$
Week 2	$6.40{\pm}0.31^{b}$	$5.83{\pm}0.33^{b}$	$5.50{\pm}0.00^{ab}$	$4.50{\pm}0.58^{a}$
Week 3	$6.43{\pm}0.28^{c}$	$5.77{\pm}0.39^{bc}$	$5.30{\pm}0.53^{b}$	$3.93{\pm}0.32^{a}$
Week 4	$6.53{\pm}0.33^{c}$	$5.90{\pm}0.21^{bc}$	$4.00{\pm}0.31^{b}$	$5.44{\pm}0.37^{a}$
Week 5	$6.57{\pm}0.32^{a}$	$5.83{\pm}0.17^{a}$	$5.47{\pm}0.14^{a}$	$4.07{\pm}0.33^{a}$
Week 6	$6.73{\pm}0.33^{a}$	$5.67{\pm}0.24^{a}$	$5.57{\pm}0.33^{a}$	$4.37{\pm}0.58^{b}$
Week 7	$6.67{\pm}0.27^{a}$	$5.67{\pm}0.24^{a}$	$5.63{\pm}0.07^{a}$	$4.50{\pm}0.58^{b}$
Week 8	$6.63{\pm}0.19^{c}$	$5.57{\pm}0.19^{bc}$	$5.83{\pm}0.88^{ab}$	$4.60{\pm}0.58^{a}$
Week 9	$6.90{\pm}0.25^{b}$	$6.80{\pm}0.61^{b}$	$5.87{\pm}0.67^{ab}$	$4.67{\pm}0.58^{a}$
Week 10	$7.70{\pm}0.23^{b}$	$6.90{\pm}0.56^{b}$	$6.10{\pm}0.21^{ab}$	$4.70{\pm}0.58^{a}$

abc =The means within the same row with different superscripts are statistically ($p<0.05$) different

Legend

T1 (Animals that ate for 10 hours without feed restriction)

T2 (Animals that ate for 7 hours with 3 hours feed restriction)

T3 (Animals that ate for 5 hours with 5 hours feed restriction)

T4 (Animals that ate for 3 hours with 7 hours feed restriction)

Table 4.5 shows the temperature of the animals which showed no significant difference ($p<0.05$) between T1 (100%), T2 (70%), T3 (50%), and T4 (30%) for week 1 and week 2. The result for week 3 indicates that there was no significant difference ($p<0.05$) between T1 (100%) and T2 (70%). But they were significantly different ($p<0.05$) from T3 (50%) and T4 (30%). Furthermore, the results for weeks 4, 5, 6, 7, 8, 9, and, 10 indicate that there was no significant difference ($p<0.05$) across the treatments. A summary of the result is presented in Table 4.5

Table 4.4 Least square mean **(**±SE) for temperature (℃) of the animals fed at different feed-time restrictions

	T1 (100%)	**T2 (70%)**	**T3 (50%)**	**T4 (30%)**
Week 1	39.00 ± 0.58^{a}	38.33 ± 0.33^{a}	38.67 ± 0.33^{a}	37.67 ± 0.33^{a}
Week 2	38.67 ± 0.33^{a}	37.67 ± 0.67^{a}	37.33 ± 0.33^{a}	37.00 ± 0.58^{a}
Week 3	38.33 ± 0.33^{a}	38.33 ± 0.33^{a}	37.33 ± 0.33^{b}	37.00 ± 0.00^{b}
Week 4	38.33 ± 0.33^{a}	36.33 ± 0.33^{a}	37.67 ± 0.67^{a}	37.67 ± 0.67^{a}
Week 5	38.33 ± 0.33^{a}	37.33 ± 0.33^{a}	38.33 ± 0.33^{a}	38.33 ± 0.33^{a}
Week 6	38.33 ± 0.33^{a}	38.67 ± 0.33^{a}	38.33 ± 0.33^{a}	38.33 ± 0.33^{a}
Week 7	38.67 ± 0.33^{a}	38.00 ± 0.58^{a}	37.67 ± 0.67^{a}	38.67 ± 0.33^{a}
Week 8	38.67 ± 0.33^{a}	38.00 ± 0.58^{a}	37.67 ± 0.67^{a}	38.67 ± 0.33^{a}
Week 9	38.33 ± 0.33^{a}	38.00 ± 0.58^{a}	37.67 ± 0.33^{a}	38.67 ± 0.33^{a}
Week 10	38.67 ± 0.33^{a}	38.67 ± 0.33^{a}	38.67 ± 0.33^{a}	38.67 ± 0.33^{a}

abc =The means within the same row with different superscripts are statistically ($p<0.05$) different

Legend

T1 (Animals that ate for 10 hours without feed restriction)

T2 (Animals that ate for 7 hours with 3 hours feed restriction)

T3 (Animals that ate for 5 hours with 5 hours feed restriction)

T4 (Animals that ate for 3 hours with 7 hours feed restriction)

Table 4.6 shows the result of haematology analysis. The PCV of the animals showed that there was no significant difference ($p<0.05$) between T2 (70%) and T3 (50%). But they were significantly different ($p<0.05$) from T1 (100%) and T4 (30%), however T1 (100%), T2 (70%), were within normal range. The result for WBC were significantly similar ($p<0.05$) for T2 (70%), T3 (50%) and T4 (30%) but significantly ($p<0.05$) different from T1 (100%), although they were all within the range. The RBC of the animals showed that T1 (100%) and T2 (70%) were significantly ($p<0.05$) similar but significantly ($p<0.05$) different from T3 (50%) and T4 (30%). They were all within range respectively. HB were all significantly ($p<0.05$) different from each other but all the treatments were within the normal range. The result for lymphocytes, neutrophils, monocyte, eosinophils, and basophils indicates that there was no significant difference ($p<0.05$) between the treatments.

Values for PCV ranged from 17.00±1.54 (T4) to 29.00±0.58 (T1). For WBC, the lowest value (5.50±0.12) in the animals was obtained in T1 while the highest value (7.00±012) was obtained in T4. For RBC, the lowest value (10.00±0.17) in the animals was obtained in T4 while the highest value (16.70±0.17) was obtained in T1. For HB, the lowest value (8.90±0.17) in the animals was obtained in T4 while the highest value (11.05±0.23) was obtained in T1. For platelets, the lowest value (154.00±1.15) in the animals was obtained in T4 while the highest value (181.00±1.73) was obtained in T1. For lymphocytes, the lowest value (43.00±1.73) in the animals was obtained in T4 while the highest value (37.00±1.73) was obtained in T1. A summary of the result is presented in Table 4.6

Table 4.5 Least square mean (±SE) for heamatology of the animals fed at different feed-time restrictions

Heamatological Indices	Normal Values	T1 (1000%)	T2 (70%)	T3 (50%)	T4 (30%)
PCV (%)	22-38	29.00±0.58[c]	23.33±0.88[b]	21.00±0.00[b]	17.00±1.54[a]
WBC ($X10^9$/L)	4-13	5.50±0.12[a]	6.07±0.17[b]	6.50±0.17[b]	7.00±012[b]
RBC ($x10^{12}$/L)	8-18	16.70±0.17[b]	16.50±0.12[b]	14.30±0.02[ab]	10.00±0.17[a]
HB (g/L)	8-12	11.05±0.23[d]	10.03±0.17[c]	9.30±0.12[b]	8.90±0.17[a]
PLATELET($x10^9$/L)	135-170	181.00±1.73[c]	176.00±1.73[c]	169.00±1.73[b]	154.00±1.15[a]
MCV (fl)	16-25	10.74±0.02[d]	9.20±0.02[c]	9.13±0.01[b]	8.49±0.03[a]
MCH (pg)	30-36	11.25±0.01[d]	11.91±0.54[c]	9.69±0.02[b]	8.92±0.02[a]
MCHC (g/dl)	30-36	33.98±0.02[d]	33.91±0.02[c]	33.61±0.12[b]	33.48±0.02[a]
LYMPHOCYTE (%)	50-70	43.00±1.73[a]	41.00±1.73[a]	39.00±1.73[a]	37.00±1.73[a]
NEUTROPHILS (%)	30-48	55.00±2.31[a]	57.00±1.73[a]	58.00±1.15[a]	60.00±1.73[a]
MONOCYTE (%)	0-4	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]
EOSINOPHILS (%)	1-8	0.00±0.00[a]	1.00±0.00[a]	1.00±0.00[a]	1.00±0.00[a]
BASOPHILS (%)	0-1	0.00±000[a]	0.00±0.00[a]	0.00±0.00[a]	0.00±0.00[a]

abc =The means within the same row with different superscripts are statistically ($p<0.05$) different.

PCV= Packed Cell Volume, WBC= White Blood Cell, RBC= Red Blood Cell, MCV= Mean Corpuscular volume, MCH= Mean Corpuscular Haemoglobin, MCHC= Mean Corpuscular haemoglobin Concentration.

Legend

T1 (Animals that ate for 10 hours without feed restriction)

T2 (Animals that ate for 7 hours with 3 hours feed restriction)

T3 (Animals that ate for 5 hours with 5 hours feed restriction)

T4 (Animals that ate for 3 hours with 7 hours feed restriction)

Table 4.7 shows the result of the Total protein of the animals which had no significant difference ($p<0.05$) between T2 (70%) and T3 (50%). However, they were significantly ($p<0.05$) different from T1 (100%) and T4 (30%) moreover T1 (100%) had the highest value and T4 (30%) had the lowest value. The results for Albumin, Glubumin, AST, and ALT were all significantly ($p<0.05$) different in all the treatments. However, there was no significant ($p<0.05$) difference for creatinine across the treatments, meanwhile T4 (30%) had the highest value and T1 (100%) had the lowest value.

Values for Total protein ranged from 26.00±1.73 (T4) to 33.00±1.15 (T1). For Albumin, the lowest value (16.59±0.02) in the animals was obtained in T4 while the highest value (18.50±0.12) was obtained in T2. For globulin, the lowest value (10.40±0.12) in the animals was obtained in T4 while the highest value (14.50±0.17) was obtained in T1. For creatinine, Cholesterol, APL, AST, and ALT, the lowest values in the animals were obtained in T4 while the highest values were obtained in T1. A summary of the result is presented in Table 4.7

Table 4.6 Least square mean (±SE) for biochemical indices of the animals fed at different feed-time restrictions

Parameters	T1 (100%)	T2 (70%)	T3 (50%)	T4 (30%)
Total protein (G/L)	33.00±1.15[b]	30.00±1.73[ab]	29.00±1.15[ab]	26.00±1.73[a]
Albumin (G/L)	18.50±0.12[d]	17.70±0.12[c]	17.20±0.12[b]	16.59±0.02[a]
Globulin (G/L)	14.50±0.17[d]	12.30±0.12[c]	11.44±0.02[b]	10.40±0.12[a]
Creatinine (μMOL/L)	26.00±1.73[a]	27.00±1.73[a]	30.00±1.15[a]	32.00±2.31[a]
Cholesterol (MMOL/L)	1.68±0.17[c]	1.52±0.02[b]	1.40±0.02[a]	1.35±0.02[a]
ALP (IU/L)	239.00±1.15[b]	220.00±1.15[a]	247.00±1.73[c]	249.00±0.58[c]
AST (IU/L)	67.50±0.17[d]	61.70±0.17[c]	54.30±0.12[b]	53.60±0.12[a]
ALT (IU/L)	21.20±0.06[d]	18.97±0.04[c]	12.70±0.12[b]	10.47±0.20[a]

abc =The means within the same row with different superscripts are statistically ($p<0.05$) different.
ALP= Alkaline Phosphatase, AST= Aspartate aminotransferase, ALT= Alanine aminotransferase

Legend

T1 (Animals that ate for 10 hours without feed restriction)

T2 (Animals that ate for 7 hours with 3 hours feed restriction)

T3 (Animals that ate for 5 hours with 5 hours feed restriction)

T4 (Animals that ate for 3 hours with 7 hours feed restriction)

Table 4.8 explained the result of the carcass analysis where the live weight of the animals showed that there was no significant difference (p<0.05) between T1 (100%), T2 (70%), and T3 (50%). However, they were significantly (p<0.05) different from T4 (30%). The result of dressed carcass showed that there was no significant difference (p<0.05) between T1 (100%) and T2 (70%). However, they were significantly (p<0.05) different from T3 (50%) and T4 (30%). The results for Head weight, leg weight, intestine, and liver were all significantly (p<0.05) different in all the treatments. However, there was no significant (p<0.05) difference for skin in T1 (100%) and T2 (70%) but they were significantly (p<0.05) different in T3 (50%) and T4 (30%). Across the treatments, animals in T1 had the highest values of carcass all through compared to other treatments. A summary of the result is presented in Table 4.8

Table 4.7 Least square mean **(**±SE) for carcass of the animals fed at different feed-time restrictions

Parameters	**T1** (100%)	**T2** (70%)	**T3** (50%)	**T4** (30%)
Live weight(kg)	6.54 ± 0.05^{b}	5.94 ± 0.62^{b}	5.60 ± 0.12^{b}	4.50 ± 0.20^{a}
Hot carcass(kg)	5.70 ± 0.06^{c}	4.60 ± 0.12^{b}	4.70 ± 0.12^{b}	3.80 ± 0.06^{a}
Dressed carcass(g)	1593.60 ± 1.10^{c}	1586.27 ± 3.53^{c}	1400.93 ± 1.35^{b}	1106.80 ± 3.09^{a}
Head weight(g)	537.31 ± 1.7^{d}	504.22 ± 1.62^{c}	263.65 ± 1.94^{b}	135.72 ± 3.15^{a}
Leg weight(g)	213.84 ± 1.22^{d}	183.31 ± 1.96^{c}	160.67 ± 0.52^{b}	120.50 ± 1.29^{a}
Skin (g)	286.59 ± 1.33^{c}	279.90 ± 8.70^{c}	263.65 ± 2.80^{b}	224.92 ± 1.50^{a}
Intestine(g)	1322.65 ± 0.53^{d}	1256.79 ± 1.39^{c}	1126.30 ± 0.51^{b}	938.47 ± 0.32^{a}
Liver(g)	121.16 ± 0.46^{d}	101.74 ± 0.20^{c}	93.04 ± 0.33^{b}	81.73 ± 0.28^{a}
Kidney(g)	25.29 ± 0.29^{b}	24.96 ± 0.81^{b}	23.88 ± 0.55^{ab}	22.64 ± 0.52^{a}
Heart(g)	39.48 ± 0.05^{c}	34.05 ± 1.30^{b}	32.53 ± 0.45^{ab}	30.91 ± 0.12^{a}
Spleen(g)	8.74 ± 0.13^{c}	8.66 ± 0.03^{c}	6.23 ± 0.01^{b}	5.78 ± 0.04^{a}
Lungs(g)	83.17 ± 0.92^{d}	79.24 ± 0.18^{c}	65.33 ± 0.68^{b}	62.74 ± 0.36^{a}

abc =The means within the same row with different superscripts are statistically ($p<0.05$) different.

Legend

T1 (Animals that ate for 10 hours without feed restriction)

T2 (Animals that ate for 7 hours with 3 hours feed restriction)

T3 (Animals that ate for 5 hours with 5 hours feed restriction)

T4 (Animals that ate for 3 hours with 7 hours feed restriction)

The outcome of this study revealed that the water intake by the animals reduced as the feeding time allotted to the animals were reduced. This outcome is consistent with the findings of (Elsheikh *et al.,* 2014) who noted significant decreases in water intake as the feeding time of the animals were reduced. Also the considerable reduction in feed intake alongside reduced feeding time observed in this study could be link to the individual differences in feeding habits exhibited by animals as reported by (Payne, 2020). However it can be deduced that the animals via their habitual actions may not be able to take in enough feed within a brief length of time. The reduction in weight gain presented in this study that consequently showed decrease in weight gain as the feeding time is reduced from 10 hours down to 3 hours daily proved the reduction in feed consumption as feeding time available for each group of the animals in a day. This result is consistent with the report of (Ajagbe *et al.*, 2020) that the animals with higher feeding time regime had a higher weight gain. The heamatology parameters accessed in this study is within normal range as reported by (Daramola *et al.,* 2005; Shahsavari *et al.,* 2016). This implies that an animal's physiological state and health are related to its environment. The result of PCV values of this study confirmed the report of (Deshmukh & Jadhav 2014; Addass *et al*., 2010) that high PCV indicates a healthy state of the animals which was evidently observed as PCV increased with increased feeding time. Low PCV values which was recorded in this study corresponded with the animals exposed to lesser feed time restriction and this is in line with the report of (Fadiyimu *et al.,* 2008) which stated the rise in PCV of WAD maybe attributed by high level of feed intake. White blood cells (WBC) in this study was within allowable range reported for healthy WAD goats by (Daramola *et al*., 2005) and they are disease resistance especially in creating antibodies. This proved that all the animal in the studied groups were protected against infection as reported by (Chukwuka *et al.,* 2010), however, the WBC values proved better with high feeding time than those allotted low feeding time and it is line with the report of (Daramola *et al*., 2005).This implied that WAD goats fed for 10 hours, 7 hours, 5 hours, and 3 hours respectively were all healthy stated by researchers (Ogunbosoye *et al.,* 2018) and animals had a strong immune system which guided them from foreign bodies. Although animals fed for 3 hours had the highest value of WBC this may be due to the feed time restriction but animals could still fight antibodies reported by **(**Gallois *et al.,* 2009)**.** RBC counts were within the normal values reported by (Daramola *et al.,* 2005). The reduction in RBC indicates the reduction in heamoglobin (HB) which results to the accessibility of oxygen by the animals although in this study animal fed for 3 hours had the lowest RBC counts but it was still within normal range as indicated by the report of (Daramola *et al.,* 2005). According to (Daramola *et al*., 2005), the treatment groups' Hb readings were within the usual range for WAD goats and Sudanese goats (Babeker & Elmansoury, 2013). Although lymphocytes can readily move through various types of tissues by using the lymphatic channels, they can also travel throughout the body by using the blood. The low lymphocyte count recorded in this study for animals is considered to be of immense clinical importance as reported by (Etim & Oguike, 2011) who claimed that lymphocytes are in charge of the body's immune-mediated defense (cell-mediated and humoral immunity), and that an absence of lymphocytes suggests that animals are more vulnerable to opportunistic and secondary infections. Therefore, the observed decline in the blood lymphocytes in this study may be traced to the feeding time allotted to the groups of the animals which showed low values with low feeding time**.** The MCV values imply the presence of heamatological features of megaloblastic anaemia due to folic acid or vitamin B deficiency (Sukumar & Saravanan, 2019). The MCV in this study that falls below the normal range (16-25fL) verified feed deprivation is not good enough for the welfare of the animals. However, the higher MCHC values recorded in this present study compared well with the values reported by (Anya, 2018). A high neutrophil values obtained as the time of feeding was reduced may be due to the level of stress the animal exposed to as a result of feed deprivation. This is in line with the report of (Bagath *et al*., 2019) who stated that the concentration of neutrophils is determined by the level of stress the animal is exposed to. The Total proteins in all the treatments were high compared to the normal range for goat reported by (Raimi & Adeloye, 2021) however, the total protein value observed were reduced with reduced feeding time and the reduction may be due to the deprivation of the time allowed for the animals as reported by (Anya, 2018) that feed deprivation has influence on the goat. The albumin in this study was high and compares with (Raimi & Adeloye, 2021) report. According to (Herranz *et al*., 2021), showed that high levels of Total Protein and Albumin were safe and beneficial which is also a very good indicator of health was observed to be normal in this present study. The low levels of globulin obtained in this study were contrary to values reported by (Esugbohungbe & Oduyemi, 2002; Ikhimioya & Imasuen, 2007) this could be as a result of feed time restriction. The abnormal high blood creatinine observed in this study indicates muscle wastage meaning that the animal survived at the expense of body reserved which also resulted in the weight loss of the animal fed over a short time. And this is in line with the report of (Olawoye *et al.,* 2020) who reported that total amount of creatinine in the blood and urine of goat and sheep are directly proportional to their body weight. This concludes that feed deprivation responsible for the weight loss observed in groups with lesser feeding time. Furthermore, the observed high value of total cholesterol from group of animals exposed to 10 hours feeding compared to others with a reduced feeding time pointed to low level of cholesterol in the animals with deprivation of feeding time and this may be a factor among many that may be linked to the weight loss observed with reduced feeding time.

The ALT values in this study for all the groups fall within the normal range of 7-24 reported by (Adedeji *et al.*, 2018) whereas, the values recorded in this work indicates reduction in the values as the feeding time reduced likewise the values for AST (Aspartate aminotransferase) fall within 43-132 reported by the same author so also ALP (alkaline phosphatase) values fall within the range of 67.1-68.25 reported by (Daramola, 2004) for female WAD goats. This result further confirmed the effects of feed deprivation on the goat fed. The results of carcass of the animals fed in this study indicate reduction in weight values is due to the feed time allotted to the animal groups. This may be an extent at which animals have access to feeding as reported by (Fadiyimu *et al.*, 2018) that higher live weight of animal could be as a result of higher feed intake and their metabolic functions. The result in the sizes of other notable organs such as the skin, intestine, spleen, kidney, heart, and liver in this study shows that feed time restrictions had a negative effect on the carcass.

5.0 CHAPTER FIVE

5.1 CONCLUSION

This study conclude that feed deprivation in term of time allowed for feeding animals have negative effects on total feed intake, water intake and weight gain of the animals. Also the result further proved through haematology and biochemical indices that low feeding time will negatively affect the health status of the animals. The carcass result as well indicated that low feeding time reduced the values of carcass.

5.2 RECOMMENDATIONS

It is here by recommended that WAD goats should at least be allowed a minimum of 5 hours testify to good feeding per day.

REFERENCES

Addass, P. A., Midau, A., & Babale, D. M. (2010). Haemato-biochemical findings of indigenous goats in Mubi Adamawa State, Nigeria. *Journal of Agriculture and Social Sciences, 6*(1), 14-16.

Adedeji, O. Y., Odukoya, S. O., Odetola, O. M., Awodele, O. A., & Saka, A. A. (2018). Growth performance and blood profile of West African dwarf goats fed urea treatedwild cocoyam (Colocasia esculentum) mea. *Nigerian Journal of Animal Production*, *45*(1), 360-366.

Adeniji, A. A., Ega, L. A., Akoroda, M. O., Adeniyi, A. A., Ugwu, B. O., & De Balogun, A. (2005). Cassava development in Nigeria. *Department of Agriculture Federal Ministry of Agricultureand Natural Resources Nigeria, FAO Africas Best Kept Secret, Michigan State University Press, USA*, 7-206.

Ahmed, E. A. Y. M. (2021). *Performance of Lactating Nubian Goats Fed Sorghum Straw and Different Concentrate Diets, Gezira State, Sudan* (Doctoral dissertation, University of Gezira).

Ajagbe, A. D., Oyewole, B. O., Abdulmumin, A. A., & Aduku, O. P. (2020). Nutrient Digestibility and Nitrogen Balance of Growing West African Dwarf (WAD) Goat Fed Nitrogen Supplemented Cassava Peel Meals. *IOSR journal of Agriculture and Vertinary Science*, *13*(1), 42-47.

Akinrinmade, J. F., & Akinrinde, A. S. (2012). Hematological and serum biochemical indices of West African dwarf goats with foreign body rumen impaction. *Niger. J. Physiol. Sci*, *27*, 83-87.

Amata, I. A. (2010). The effect of feeding *Gliricidia* leaf meal (GLM) on the haematological, serological and carcass characteristics of weaned rabbits in the tropics. *Agric Biol J North America*, *1*(5), 1057-1060.

Anya, M. I., Ozung, P . O. and Igwe, P . A. 2018. Blood prole of west African dwarf (WAD) bucks Fed Raw and processed cocoa pod husk meal based –diets in the humid high rainforest zone of Nigeria. Global journal of pure and applied sciences , 24, 125-134

Araújo, G. G. L. D., Voltolini, T. V., Chizzotti, M. L., Turco, S. H. N., & Carvalho, F. F. R. D. (2010). Water and small ruminant production. *Revista Brasileira de Zootecnia*, *39*, 326-336.

Archimede, H.; Eugene, M.; Magdeleine, C. M.; Boval, M.; Martin, C.; Morgavi, D. P.; Lecomte, P. and Doreau, M. 2011. Comparison of methane production between C3 and C4 grasses and legumes. Animal Feed Science and Technology 166-167:59-64.

Ariyibi, A.A., Oyeyemi, M.O. and Ajadi, R.A. (2002) A Comparative Study of Some Hematological and Biochemical Parameters of Clinically Healthy Alsatian and Local Dogs. African Journal of Biomedical Research, 5, 145-147.

Babeker, E. A., & Elmansoury, Y. H. A. (2013). Observations concerning haematological profile and certain biochemical in Sudanese desert goat. *Journal of Animal and Feed Research*, *3*(1), 80-86.

Bagath, M., Krishnan, G., Devaraj, C., Rashamol, V. P., Pragna, P., Lees, A. M., & Sejian, V. (2019). The impact of heat stress on the immune system in dairy cattle: A review. *Research in veterinary science*, *126*, 94-102.

Balehegn, M., Duncan, A., Tolera, A., Ayantunde, A. A., Issa, S., Karimou, M., ... & Adesogan, A. T. (2020). Improving adoption of technologies and interventions for increasing supply of quality livestock feed in low-and middle-income countries. *Global Food Security*, *26*, 100372.

Boddey, R. M., Casagrande, D. R., Homem, B. G., & Alves, B. J. (2020). Forage legumes in grass pastures in tropical Brazil and likely impacts on greenhouse gas emissions: A review. *Grass and Forage Science*, *75*(4), 357-371.

Brewbaker, J. L. (2004). Nitrogen-fixing Tree Improvement and Culture in Tree Breeding Practices. *Hawaii: Elsevier*, 1490-501.

Chukwuka, O. K., Okoli, I. C., Okeudo, N. J., Opara, M. N., Herbert, U., Ogbuewu, I. P., & Ekenyem, B. U. (2010). Reproductive potentials of West African Dwarf sheep and goat: A review. *Research Journal of Veterinary Sciences*, *3*(2), 86-100.

Cienfuegos, S., Gabel, K., Kalam, F., Ezpeleta, M., Wiseman, E., Pavlou, V., ... & Varady, K. A. (2020). Effects of 4-and 6-h time-restricted feeding on weight and cardiometabolic health: a randomized controlled trial in adults with obesity. *Cell metabolism*, *32*(3), 366-378.

Daramola, J. O. And Adeloye, A. A. 2009. Physiological Adaptation to the Humid Tropics with Special Reference to the West African Dwarf (WAD) Goat. Tropical Animal Health Production

Daramola, J. O., Adeloye, A. A., Fatoba, T. A., Soladoye, A. O. 2005. Haematological and biochemical parameters of West African Dwarf goats. Livestock Research for Rural Development, 17(8), 3. 7.

DASH, S. K., SINGH, C., AHUJA, C. S. and SINGH, D. (2013). A comparative study of some hematological and serum biochemical parameters of clinically healthy Labrador and Spitz. International Journal of Advanced Veterinary Science and Technology, 2(1): 52 – 58.

de Carvalho Franca, L. F., da Silva, F. R. P., di Lenardo, D., Alves, E. H. P., Nascimento, H. M. S., da Silva, I. A. T., ... & Vasconcelos, D. F. P. (2019). Comparative analysis of blood parameters of the erythrocyte lineage between patients with chronic periodontitis and healthy patients: results obtained from a meta-analysis. *Archives of oral biology*, *97*, 144-149.

de Moura, J. G., da Cunha, M. V., de Souza, E. J. O., Coelho, J. J., dos Santos, M. V. F., Júnior, J. C. B. D., & de Mello, A. C. L. (2021). The vegetal stratum defined the forage bromatology more than the season in seasonal dry tropical forest rangelands. *Agroforestry Systems*, 1-13.

Desforges, J. P., van Beest, F. M., Marques, G. M., Pedersen, S. H., Beumer, L. T., Chimienti, M., & Schmidt, N. M. (2021). Quantifying energetic and fitness consequences of seasonal heterothermy in an Arctic ungulate. *Ecology and evolution*, *11*(1), 338-351.

Deshmukh, S. R., & Jadhav, V. D. (2014). Haematological parameters of Indian goats fed dried Clitoria leaves-based diets. *European Journal of Experimental Biology*, *4*(4), 73-77.

Dhama, K., Latheef, S. K., Mani, S., Samad, H. A., Karthik, K., Tiwari, R., ... & Tufarelli, V. (2015). Multiple beneficial applications and modes of action of herbs in poultry health and production-A review. *International Journal of Pharmacology*, *11*(3), 152-176.

Dias-Silva, T. P., & Abdalla, A. L. (2020). Sheep and goat feeding behavior profile in grazing systems. *Acta Scientiarum. Animal Sciences*, *43*.

Ekundayo, J. A. (1980). Biotransformation of cassava peel in the Niger Delta area of Nigeria using enhanced natural attenuation. *Fungal biotechnology*, 244-2701.

Elsheikh, E. M., Ali, O. H., & Abdoun, K. A. (2014). Effect of restricted feeding on physiological performance in male Nubian goat kids.

Esugbohungbe, O. O. and Oduyemi, A.O. 2002. Comparisons of nutritional potentials of Terminalia catappa and Acalypha wilkesiana leaves as sole feed for goats. In: Increasing household protein consumption t h r o u g h imp r o v e d l i v e st o c k production, (eds. V.A. Aletor and G.E. th Onibi). Proceedings of the 27 Annual conference of the Nigerian Society of 140 Oni, Sowande., Oduguwa, Yusuf, Arigbede and Onwuka Animal Production held at Federal University of Technology, Akure, Nigeria, March 17-21, Pp. 205-208.

Etim, N. N., & Oguike, M. A. (2011). Haematology and serum biochemistry of rabbit does fed Aspilia africana. *Nigerian Journal of Agriculture, Food and Environment*, *7*(4), 121-127.

Fadiyimu, A. A., Alokan, J. A., & Fajemisin, A. N. (2010). Digestibility, nitrogen balance and haematological profile of West African dwarf sheep fed dietary levels of Moringa oleifera as supplement to Panicum maximum. *Journal of American science*, *6*(10), 634-643.

Fadiyimu, A.A.; Fajemisin, A.N.; Alokan, J.A. Chemical composition of selectedbrowse plants and their acceptability by West African Dwarf sheep. LivestockResearch for Rural Development, 2018, 23(12)

FAO,2005.Cassava Development in Nigeria. Available at http://www.fao.org/3/a0154e/A0154E05.htm. Accessed on May 3, 2022.

Fazio, F. (2019). Fish hematology analysis as an important tool of aquaculture: a review. *Aquaculture*, *500*, 237-242.

Fischer, A. W., Cannon, B., & Nedergaard, J. (2020). Leptin: Is It Thermogenic?. *Endocrine reviews*, *41*(2), 232-260.

Flay, H. E., Kuhn-Sherlock, B., Macdonald, K. A., Camara, M., Lopez-Villalobos, N., Donaghy, D. J., & Roche, J. R. (2019). Hot topic: Selecting cattle for low residual feed intake did not affect daily methane production but increased methane yield. *Journal of dairy science*, *102*(3), 2708-2713.

Fletcher, J. A., Deja, S., Satapati, S., Fu, X., Burgess, S. C., & Browning, J. D. (2019). Impaired ketogenesis and increased acetyl-CoA oxidation promote hyperglycemia in human fatty liver. *JCI insight*, *4*(11).

Gallois, M., Rothkötter, H. J., Bailey, M., Stokes, C. R., & Oswald, I. P. (2009). Natural alternatives to in-feed antibiotics in pig production: can immunomodulators play a role?. *Animal*, *3*(12), 1644-1661.

Gerken, M., Brinkmann, L., Runa, R. A., & Riek, A. (2019). Water Metabolism in South American Camelids. *Gutiérrez, Lisa McKenna, Roman Niznikowski, Maria Wurzinger* *(eds.) Advances in Fibre Production Science in South American Camelids and other Fibre Animals*, 267.

Ghanem, A. M., Jaber, L. S., Abi Said, M., Barbour, E. K., & Hamadeh, S. K. (2008). Physiological and chemical responses in water-deprived Awassi ewes treated with vitamin C. Journal of Arid Environments, 72(3), 141-149.

Goetsch, A. L. (2019). Recent research of feeding practices and the nutrition of lactating dairy goats. *Journal of Applied Animal Research*.

Herranz, B., Criado, C., Pozo-Bayón, M. Á., & Álvarez, M. D. (2021). Effect of addition of human saliva on steady and viscoelastic rheological properties of some commercial dysphagia-oriented products. *Food Hydrocolloids*, *111*, 106403.

Hershey, C., Henry, G., Best, R., Kawano, K., Howeler, R. H., & Iglesias, C. (2001). Cassava in Asia: Expanding the competitive edge in diversified markets. *A review of cassava in Asia with country case studies on Thailand and Vietnam*.

Hill, C. M., Laeger, T., Dehner, M., Albarado, D. C., Clarke, B., Wanders, D., . . . Morrison, C. D. (2019). FGF21 signals protein status to the brain and adaptively regulates food choice and metabolism. *Cell Reports*, *27*(10). doi:10.1016/j.celrep.2019.05.022

Hou, Y., He, W., Hu, S., & Wu, G. (2019). Composition of polyamines and amino acids in plant-source foods for human consumption. *Amino Acids, 51*(8), 1153-1165. doi:10.1007/s00726-019-02751-0

Hristov, A. N.; Oh, J.; Firkins, J. L.; Dijkstra, J.; Kebreab, E.; Waghorn, G.; Makkar, H. P. S.; Adesogan, A. T.; Yang, W.; Lee, C.; Gerber, P. J.; Henderson, B. and Tricarico, J. M.

2013. Special topicsMitigation of methane and nitrous oxide emissions from animal operations: I. A review of enteric methane mitigation options. Journal of Animal Science 91:5045-5069.

Ibrahim, M., Ayoub, D., Wasselin, T., Van Dorsselaer, A., Le Maho, Y., Raclot, T., & Bertile, F. (2020). Alterations in rat adipose tissue transcriptome and proteome in response to prolonged fasting. *Biological chemistry*, *401*(3), 389-405.

Ikhimioya, I. and Imasuen, J.A. 2007. Blood profile of West African dwarf goa ts f ed Pani cum max imum supplemented with Afzelia Africana and Newbouldia laevis. Pakistan Journal of Nutrition, 6(1): 79-84.

Ikuemonisan, E. S., Mafimisebi, T. E., Ajibefun, I., & Adenegan, K. (2020). Cassava production in Nigeria: trends, instability and decomposition analysis (1970–2018). *Heliyon*, *6*(10), e05089.

Jamshed, H., Beyl, R. A., Della Manna, D. L., Yang, E. S., Ravussin, E., & Peterson, C. M. (2019). Early time-restricted feeding improves 24-hour glucose levels and affects markers of the circadian clock, aging, and autophagy in humans. *Nutrients*, *11*(6), 1234.

Janssen, P. H. and Kirs, M. 2008. Structure of the archaeal community of the rumen. Applied Environmental Microbiology 74:3619-3625.

Jha, R., Singh, A. K., Yadav, S., Berrocoso, J. F. D., & Mishra, B. (2019). Early nutrition programming (in ovo and post-hatch feeding) as a strategy to modulate gut health of poultry. *Frontiers in veterinary science*, *6*, 82.

Kubkomawa, H. I. (2019). Nutrient requirements of livestock for sustainable productivity in tropical Africa: a review. *Journal of Emerging Trends in Engineering and Applied Sciences*, *10*(5), 247-272.

Mansoor, A. I., & Fadlalla, B. (2021). Diet Selection by Goats at Kalemando, North Darfur, Sudan.

Marsetyo , Damry , Quigley SP, McLennan SR, Poppi DP (2012) Live weight gain and feed intake of early weaned Bali cattle fed a range of diets in Central Sulawesi, Indonesia. Animal Production Science 52, 630–635. doi:10.1071/AN11285

Masters, D. G., Norman, H. C., & Thomas, D. T. (2019). Minerals in pastures—are we meeting the needs of livestock?. *Crop and Pasture Science*, *70*(12), 1184-1195

Maurya, V. P., Sejian, V., Kumar, D., & Naqvi, S. M. K. (2020). Impact of heat stress, nutritional stress and their combinations on the adaptive capability of Malpura sheep under hot semi-arid tropical environment. *Journal of Animal Behaviour and Biometeorology*, *7*(1), 17-23.

Modra, H., Palikova, M., Hyrsl, P., Bartonkova, J., Papezikova, I., Svobodova, Z., ... & Mares, J. (2020). Effects of trichothecene mycotoxin T-2 toxin on haematological and immunological parameters of rainbow trout (Oncorhynchus mykiss). *Mycotoxin research*, *36*, 319-326.

Na-Allah, Y., & Akoh, J. J. (2020). Biomass Estimation and Proximate Composition of Herbage at Moreh Grazing Land in Kware Local Government Area of Sokoto State, Nigeria.

Ofuya, C. O., & Obilor, S. N. (1993). The suitability of fermented cassava peel as a poultry feedstuff. *Bioresource technology*, *44*(2), 101-104.

Ogunbosoye, D. O., Akinfemi, A., & Ajayi, D. A. (2018). Blood profiles of West African dwarf (WAD) growing bucks fed varying levels of shea nut cake based rations in Nigeria. *Cogent Food & Agriculture*, *4*(1), 1474620.

Olawoye, S. O., Okeniyi, F. A., Adeloye, A. A., Alabi, O. O., Shoyombo, A. J., Animashahun, R. A., & Yousuf, M. B. (2020). Effects of formulated concentrate and palm kernel cake supplemen-tation on performance characteristics of growing West African dwarf (WAD) goat kids. *Nigerian Journal of Animal Science*, *22*(2), 287-295.

Ologun, A.G. (2004): Inaugural lecture series 37, Delivered at FUT, Akure, May 25th, 2004

Oloruntola, O. D., Ayodele, S. O., Agbede, J. O., & Asaniyan, E. K. (2016). Performance and apparent digestibility of broiler starter fed diets containing *Gliricidia* sepium leaf meal. *Asian Journal of Biological and Life Science*, *5*(1).

Oloruntola, O. D., Daramola, O. T., & Omoniyi, S. O. (2015). Effect of forages on performance, carcass cuts and haematological profile of weaner rabbits. *Archivos de zootecnia*, *64*(245), 87-92.

Payne, H. L., Lynch, G. F., & Aronov, D. (2020). Precise spatial representations in the hippocampus of a food-caching bird. *bioRxiv*.

Pellegrini, M., Cioffi, I., Evangelista, A., Ponzo, V., Goitre, I., Ciccone, G., ... & Bo, S. (2020). Effects of time-restricted feeding on body weight and metabolism. A systematic review and meta-analysis. *Reviews in Endocrine and Metabolic Disorders*, *21*(1), 17-33.

Pinotti, L., Giromini, C., Ottoboni, M., Tretola, M., & Marchis, D. (2019). Insects and former foodstuffs for upgrading food waste biomasses/streams to feed ingredients for farm animals. *Animal*, *13*(7), 1365-1375.

Prasad, K., Recek, N., Zhou, R., Zhou, R., Aramesh, M., Wolff, A., ... & Ostrikov, K. K. (2019). Effect of multi-modal environmental stress on dose-dependent cytotoxicity of nanodiamonds in Saccharomyces cerevisiae cells. *Sustainable materials and technologies*, *22*, e00123.

Raimi, O. C., & Adeloye, A. A. (2021). Blood Count and Serum Biochemistry Profile in West African Dwarf Goats Fed Ensiled Mixtures of Cocoa Pod, Cassava Pulp and Acacia Leaf.

Raphael, O. D., Alhassan, E. A., Fasinmirin, J. O., & Okunola, A. A. (2019). CLIMATE AND SOIL CHARACTERIZATION IN IRRIGATION PLANNING FOR BELL PEPPER IN THE HUMID CLIMATE OF OMU-ARAN, NIGERIA. *International Journal of Civil Engineering and Technology (IJCIET)*, *10*(1), 1051-1065.

Sejian, V., Silpa, M. V., Reshma Nair, M. R., Devaraj, C., Krishnan, G., Bagath, M., ... & Bhatta, R. (2021). Heat Stress and Goat Welfare: Adaptation and Production Considerations. *Animals*, *11*(4), 1021

Shahsavari, A., Michael, J. D., & Al Jassim, R. (2016). The role of rumen-protected choline in hepatic function and performance of transition dairy cows. *British Journal of Nutrition*, *116*(1), 35-44.

Silanikove, N. 2000. The physiological basis of adaptation in goats to harsh environments. Small Ruminant Research 35:181-193.

SIMSEK, O., CINAR, M. and ARIKAN, S. (2015). Changes in selected hematology and serum biochemistry in Turkish Angora cats (Felis catus) during growth period. Journal of Advanced Veterinary and Animal Research, 2(1): 34 – 39

Strydom, K., Van Niekerk, E., & Dhansay, M. A. (2019). Factors affecting body composition in preterm infants: Assessment techniques and nutritional interventions. *Pediatrics & Neonatology*, *60*(2), 121-128.

Sukumar, N., & Saravanan, P. (2019). Investigating vitamin B12 deficiency. *BMJ*, *365*.

Sulendre, I. W., Takdir, M., Harper, K. J., & Poppi, D. P. (2021). Formulating diets based on whole cassava tuber (Manihot esculenta) and gliricidia (Gliricidia sepium) increased feed intake, liveweight gain and income over feed cost of Ongole and Bali bulls fed low quality forage in Central Sulawesi, Indonesia. *Animal Production Science*, *61*(8), 761-769.

Valenzuela-Grijalva, N. V., Pinelli-Saavedra, A., Muhlia-Almazan, A., Domínguez-Díaz, D., & González-Ríos, H. (2017). Dietary inclusion effects of phytochemicals as growth promoters in animal production. *Journal of animal science and technology*, *59*(1), 1-17.

Wang. T., Hung, C.C. andRandall, D. J. 2006. The comparative physiology of food deprivation: from feast to famine. Annual Review of Physiology, 68: 223-251.

Wani, M.G. (2010). Water requirements of desert goats. http://aussiesheep.com/water-requirments-ofdesert-goats-by-ghulam-mohyuddin-wani/400/.

Wreford, A., & Topp, C. F. (2020). Impacts of climate change on livestock and possible adaptations: A case study of the United Kingdom. *Agricultural Systems*, *178*, 102737.

Yousif, H. S. (2019). Some physiological responses in Nubian goats exposed to heat load. *Int. J. Sci. Eng. Sci*, *3*, 6-9.