EFFECT OF COCOYAM LEAF AND RICE STOVER SUPPLEMENT DIETS ON HAEMATOLOGICAL PARAMETERS OF YOUNG FEMALE WEST AFRICAN DWARF GOATS

BY

DARAMOLA OPEOLUWA FELICIA

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November, 2017

DECLARATION

I **DARAMOLA, OPEOLUWA FELICIA** hereby declare that this project **"Effect of Cocoyam leaf and Rice Stover supplement diets on the haematological parameters of young West African Dwarf Goats"** has been written by me and that it is a record of my own research work . It has not been presented before in any previous application of a degree or any reputable presentation elsewhere. All borrowed ideas have been duly acknowledged.

.... 12 / 12 / 2017

DARAMOLA ,OPEOLUWA FELICIA DATE

(STUDENT)

CERTIFICATION

This is to certify that this project **"Effect of Cocoyam leaf and Rice Stover on haematological parameters of young female West African Dwarf Goats"** was undertaken by Daramola Opeoluwa felicia (ASC/12/0456) of the Department of Animal Production and Health, Faculty of Agriculture, Federal University Oye-Ekiti, Ekiti State. In partial fulfillment of the requirements for the award of a Bachelor of Agriculture (B.Agric) degree in Agriculture Science.

Daramola, Opeoluwa Felicia (Student)	12/12/2017 Date
Dr. Jesuyon O.M.A (Project Supervisor)	Date
Dr. Ekeocha A.H (Head of Department)	14/12/17 Date

DEDICATION

I dedicate the project to the Almighty God, the giver of life, the defender of the helpless and who made my academic achievement a reality. And also, to my lovely and caring parents, Mr. and Mrs. Emmanuel Alani Daramola and siblings for their roles in laying a strong foundation for my academic life.

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My profound gratitude goes to Almighty God the beneficent and the merciful, all praise and adoration belongs to Him who made my existence a possibility and has so far been in the control of my life and also promises to be in control forever.

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My utmost appreciation goes to my father and mother, siblings and other family members who endured this long process with me, always offering love, prayers, and support. Finally, my greatest gratitude to the lord who turned impossibilities into possibilities.

ABSTRACT

This study was conducted to evaluate the effect of cocoyam leaf and rice stover supplement diets on the haematological parameters of the young female West African Dwarf (WAD) goats. The experiment was carried out at the Animal Production and Health Departmental Teaching and Research Farm, Faculty of Agriculture, Federal University Oye-Ekiti and the laboratory analysis was at Fasanmade medical laboratory ADO-EKITI between May-July. Nineteen young female (WAD) goats received 100g daily of an assigned diet in a completely randomized design for 90days. The diets evaluated were Rice Stover, Cocoyam leaf and Rice Stover + Cocoyam Leaf supplement diets and these were compared to a control diet: pasture browsing. Portable drinking water was provided for each animal *ad-libitum*. Blood samples were collected from the jugular vein of individual animal monthly to evaluate Red blood cell (RBC), Haemoglobin concentration (HB) , Packed cell volume (PCV), mean corpuscular volume (MVC) , Mean corpuscular haemoglobin (MCH), Mean cell haemoglobin corpuscular (MCHC), White blood corpuscular (WBC), and WBC Differentials. Results show that there were no significant ($p>0.05$) differences in the parameters evaluated between diets and control. RBC (Red blood cell) ranges between 6.46±0.92 and 5.26±0.44. Haemoglobin concentration (HB) ranges between 7.11±0.48 and 6.12±0.40, Packed cell volume (PCV) ranges between 0.24±0.01 and 0.18±0.01, Mean corpuscular volume (MVC) ranges between 56.13±23.58 and 31.64±1.01, Mean corpuscular haemoglobin (MCH) ranges between 16.70±6.48 and 10.40±0.85 Mean cell haemoglobin corpuscular (MCHC) ranges between 33.25±1.38 and 30.90±1.58, White blood corpuscular (WBC) ranges between 15.05±1.86 and 12.20±1.56. It is concluded from results of study that cocoyam leaf + rice stover supplement diet could be used to feed goat during the period of its abundance after harvest without any deleterious effect on the animal.

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CHAPTER ONE

1.0 INTRODUCTION

Livestock productivity in the tropics has suffered major setbacks due to inadequate quantity and quality feeds for animals, especially during dry season (Peters, 1998). In wet season, forage is relatively available and small ruminants could easily gain weight and remain thrifty. (Babayemi *et al.*, 2003; Akinlade *et al.*, (2005) it has been reported that a major problem facing small ruminant animal producers is how to feed the animals adequately all year round (Fasae *et al.*,2009). Small ruminant production in dry season could be improved upon by cultivating forage plants with high leaf yield (Fasae *et al.*, 2009). These crops when harvested, could be dried and stored as food for ruminants during the scarce period, when these animals lose a considerably percentage of their body weight as a result of shortage of good quality forage.

The domesticated goat (*Capra hircus*) is found throughout the continent. Nigeria has a WAD population of 29.2million (FAO, 2005). The West African Dwarf (WAD) goat is the indigenous hardy breed of goat in the humid and derived Savannah zones of West Africa. They are characterized by small size, early sexual maturity, lower nutrient requirement and capital cost. Babayemi *et al.*, (2003) these attributes in addition to their hardiness enhance their productivity with rapid capital turn over if well managed. In the south-eastern zone of Nigeria, WAD goats are mostly raised by the traditional semi-intensive management system with cut-and-carry grass as the major source of nutrition. There is hardly any feed supplementation. This is one of the major constraints to WAD goat productivity as the quality and quantity of the grass vary with season. Akinlade *et al.*, (2005).

The genetic makeup of WAD goats is believed to influence most production attributes such as birth and weaning weights, size and weight at maturity, fecundity, etc. Devendra, (1974).In Nigeria, the rearing of goats, most especially the West African Dwarf is mainly traditional, and as a result, it is characterized by inadequate feeding. This has necessitated the search for non – conventional feedstuffs, which are cheap and not in high demand by humans (Amaefule, 2002). Furthermore, the limited supply of raw materials for the livestock feed industry has resulted in a continuous increase in the cost of production, causing phenomenal rise in the unit cost of production of livestock (Onwuka *et al.*, 1992). The shortage of good quality feed needed to sustain livestock growth especially during dry season months has been a perennial problem which can be reduced or eliminated by finding alternative source of protein and energy concentrate for their feeding.

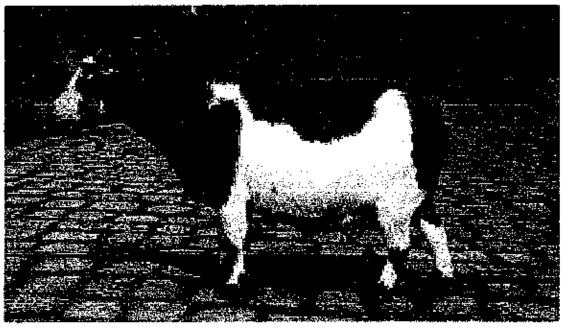

Plate 1: West African Dwarf Goat

Source: https://upload.wikimedia.org

Several studies have shown that fruits and vegetables contribute to protecting against degenerative pathologies such as cardiovascular diseases, diabetes, and cancer, mainly due to the presence of dietary fiber (DF) and polyphenols. The role of ruminants cannot be overemphasized as ruminants play significant roles in the socio-economic wellbeing of Nigerians in various ways. Economically goats serve as source of income earning to producer, middlemen and butchers/meat sellers; generates employment and creates markets for large number of people who explore the animals' product and by-products for economic gains. The Small ruminants also have several degrees of social values especially in the South-western and South-eastern parts of Nigeria.

Given the importance of WAD goats, efforts to ensure a sustainable production is encouraged. This has led to the introduction of non-conventional and supplementary feeding in the production. These non-conventional feedstuffs are of huge importance because of their nutritional values, and their economic role in feeding during dry seasons.

Cocoyam, a member of the *Araceae* family is an ancient crop grown throughout the humid tropics for its edible corns, cormels and leaves, as well as for other traditional uses. The Aracaea family is made up of hundred genera and more than fifteen hundred species (Encarta, 2006). They are mostly tropical and subtropical. They are cultivated mainly in moist or shady habitats. Some are terrestrial while others are vines, creepers or climbers. Cocoyam is a well-known food plant which has a long history of cultivation. Its corns are important source of starch. The leaf stalk and matured leaves are also eaten as vegetables. The fresh cocoyam leaf has a moisture content of 88.5%, Protein 2.7%, Ether extract 0.4%, Ash 2.8%, Carbohydrate 2.1%, Vitamin C 15% per 100g, β carotene 16% per 100g. (Odedeji *et al,* 2014).

On the other hand, the rice bran which is also known as miller's bran is the hard outer layer of the rice grain. The stabilized rice bran has the following nutrient compositions: protein (g) 17.5, Fat (g) 13.1, Crude fibre (g) 7.85, Insoluble dietary fibre (g) 21.17 while the probiotic rice bran contains protein (g) 19.25, fat (g) 17.2, crude fibre (g) 4.96, insoluble dietary fibre (g) 13.1.

The Rice stover has a low nutritional value due to its silica content, low ruminal degradation of its carbohydrates and low nitrogen content when stored in bales. Despite its low nutritional value, it presents significant potential for strategic use in critical periods of food availability.

The diet fed to farm animal plays vital roles in its growth, development and health Tambuwal *et al.*, (2002). The study of hematological and biochemical indices are essential to determine the health status of farm animals (Tambuwal *et al.*, 2002; Orheruata and Aikhuomobhogbe, 2006). There is a great variation in the haematological and biochemical parameters between breeds of goats (Meyer and Harvey, 1998). Normal blood values are defined as those of clinically healthy animals kept under normal housing conditions and fed balance ration. Meyer and Harvey (1998) noted that the ingestion of numerous dietary components have measurable effect on blood constituent. An understanding of hematological indices of domestic animals gives an indication of the health status of the animals. This study therefore is designed to evaluate the hematological parameters of West African Dwarf goats fed Rice stover and cocoyam leaf based diets as there is a dearth of information on the hematological parameters on WAD fed on the above named diets.

1.1 PROBLEM STATEMENT

Problems in goat production are not a new phenomenon. It has assumed a greater and uncomfortable dimension since 1980s. These problems in Nigeria includes lack of training in knowledge of production among local farmers, inability to access drugs and vaccines for treating goat diseases, poor management methods of goat production and the low level of government intervention in goat farming. In addition to these, supplemental feeding has been on the increase as these farm animals cannot rely on the forages and pastures which are in situ in the environment alone especially during the dry season; and as well might lack some of the essential nutrients needed by ruminants. Furthermore, this feed material might contain some anti-nutritional values, which are detrimental to the health of the animals hence, the need to evaluate their hematological indices as influenced by the diets being fed to them.

1.2 JUSTIFICATION

This research will help farmers to know the effect of feeding West African Dwarf goats with Cocoyam leaves and rice stover which can be beneficial or detrimental. The effect of diets on blood haematological parameters determines the health status of animal will be evaluated. Hence, this research will be beneficial to farmers, and will also be a foundation for further researches as there is inadequate information on the hematological parameters of WAD goats as influenced by cocoyam leaf and rice stover based diets.

1.3 OBJECTIVES

The aims of study are:

1. To determine the haematological parameters of young West Africa Dwarf (WAD) goats fed experimental diets containing Rice stover and Cocoyam leaf.
2. To evaluate the general health status of goats on test diets.

1.4 HYPOTHESIS

H_O: There are no significant differences between the means of blood parameters of diet groups.

H_A: There are significant differences between the means of blood parameters of diet groups

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 ORIGIN AND DISTRIBUTION OF COCOYAM

Cocoyam refers to two members of the *Araceae* family that are staple foods for many people in developing countries in Africa, Asia and the Pacific Talwana *et al.*, (2009), namely *Colocasia esculentum (L.) Schott) and Xanthosoma sagittifolium(L.) Schott.*

Although the two crops are members of the same *Araceae* family, *C. esculenta*, also known as dasheen and eddoe, is considered to have originated in the Indo-Malaysian region, perhaps in eastern India and Bangladesh from where it spread eastwards into southern Asia and the pacific islands and westwards to Egypt and the Eastern Mediterranean. *C. esculenta* is thought to have been domesticated in northern India, but independent domestication in New Guinea has also been suggested (Safo-Kantaka, 2004). Domestication is believed to have taken place at a very early date, even before the domestication of rice. It was spread by human settlers eastward to New Guinea and the Pacific over 2000 years ago, where it became one of the most important food plants economically and culturally. Distribution to China and via Arabia to Egypt and East Africa also occurred at least 2000 years ago. From there *C. esculenta* was introduced by Arab people to West Africa. It was introduced into Europe from Egypt (Cabi.org 2017).

During the seventeenth century, *C. esculenta* was introduced from Africa to the Americas as a food crop for slaves by Spaniard, Portuguese, and British slave traders (Cabi.org 2017). For example, as early as 1647, taro was cultivated in Barbados as a slave dietary staple Carney and Rosomoff, (2009). Later, by 1864, it was reported as "naturalized" in Jamaica and St. Kitts and widely cultivated in most islands in the West Indies (Cabi.org 2017). In Puerto Rico, the first report of this species was made by Bello in 1883. In the southeastern United States, it was introduced in 1910 by the Department of Agriculture as a substitute crop for potatoes (Langeland *et al.*, 2008). *C. esculenta* can be found growing mainly in moist forests and wet areas in riparian habitats, riverbanks, along streams, marshes, and canals (Safo-Kantaka, 2004; Acevedo-Rodríguez and Strong, 2005; Langeland *et al.*, 2008). It can also be found in secondary forests, roadsides, and disturbed areas near to abandoned crop fields (Wagner *et al.*, 1999; Acevedo-Rodríguez and Strong, 2005).

In Puerto Rico, this species escaped from cultivation and persists along riverbanks and in moist forest understory in Arecibo, Caguas, Carolina, Jayuya, Loíza, Salinas, San Juan, and Toa Baja (Acevedo-Rodríguez and Strong, 2005). In Florida, this weed was widely naturalized along streams, marshy shores, canals, and ditches in more than 235 public water bodies by 1994 (Langeland *et al.*, 2008).

In Australia, *C. esculenta* is an environmental weed invading waterways and wetlands and replacing native aquatic plants. It is listed among the 200 most invasive plants in the region of Queensland and is also a problem in the coastal districts of New South Wales and along the waterways in Western Australia (Queensland Department of Primary Industries and Fisheries, 2011).

Today it is cultivated in the Caribbean, Central and Tropical America, West and Central Africa, South East Asia, Oceania and New Caledonia (Giacometti and Léon, 1994). It is an important source of calories for nearly 400 million people worldwide (Onokpise*et al.*, 1999). With the introduction of the crop in the Atlantic Coast of the United States of America where it is now consumed by Latin Americans, there has been renewed interest in its cultivation (Giacometti and Léon, 1994).

On the other hand, *Xanthosoma spp.* (also known as tanier, yautia, malaga and new cocoyam) is native to tropical Central and South America and the Caribbean where it has been cultivated and consumed since the pre-Columbian epoch (Onwueme, 1994). Therefore, with increasing land degradation as evidenced by declining soil fertility, decreasing vegetation cover and water availability, wetlands are providing alternative centres for agricultural productivity (Barbier, *et al.*, 1997) including a large part of the East African region (Mafabi, 2000; Maclean *et al.*, 2003; Ndaruga and Irwin, 2003) and cocoyam is among the major crops grown in these wetlands.

According to the FAO (2013), the cultivation of *X. sagittifolium* must be very old in the New World. It may have originated in the northern part of South America and spread through the West Indies and Mesoamerica. When the Europeans arrived to America, the cultivation of this plant species was known from Central America to Bolivia, but more intensive in the West Indies (FAO, 2013). In Florida (USA), where it is listed as invasive, it has been cultivated commercially since 1963, but may have been introduced earlier for ornamental purposes (Cabi.org, 2017). From the Americas, *X. sagittifolium* reached West Africa probably during the seventeenth or eighteenth centuries, associated with the slave trade. In Africa, this species has traditionally been a subsistence crop (FAO, 2013; Prota4U, 2013).

The native distribution range of *X. sagittifolium* is unclear, but it is suggested that it is native to northern South America including Colombia, Peru, Ecuador and Venezuela (Manner, 2011; Govaerts, 2013). It is widely naturalized in the West Indies, Central America, tropical Africa, tropical Asia and islands in the Pacific Ocean (Acevedo-Rodríguez and Strong, 2012; Govaerts, 2013; PIER, 2013; Prota4U, 2013).

*X. sagittifolium*is one of the oldest cultivated crops in the world. It grows best in humid tropical rainforest climates and can be found naturalized along stream banks and in moist shady areas (Manner, 2011). In Florida, it can be found in disturbed wetlands, mesic pinelands, wet ditches, and adjacent to freshwater swamps and springs (Langeland *et al.*, 2008). In the West Indies, it is cultivated and naturalized in moist or wet, disturbed areas (Acevedo-Rodríguez and Strong, 2005).

Cocoyam is a well-known food plant, which has a long history of cultivate. It constitutes one of the basic food crops of major economic importance in Nigeria. (chukwu*et al.,* 2007), stated that it ranks the third after cassava and yam in terms of total production, land area under crop and consumption. Its corms are important source of starch. They may also be cut up and boil in curries or fried to make crispy chips. The leaf stalks can also be eaten. The leaves which are seldomly used for food have been reported that they can be cooked (Agrid 2006). All parts of the of the raw cocoyam plant contain a toxic compound calcium oxalate, which must be destroyed through cooking before eating (Olaleye *et al.,* 2013).The plant is herbaceous in nature and it is capable of growing to a height of 2meters. They seldom flower and fruit in cultivation and the flowers expectedly possesses the usual aroid flower structure. The leaves of cocoyam are shape like a shield and can reach up to a meter in length; they are attached to the long, fleshy leafy stalks that are green, red or purple. Slightly off the center of each leaf blade and such a characteristic is desert, be as peltake (Lyj and Preston1997).

Reports have shown that cocoyam corm supply easily digestible starch and are known to contain substantial amount of protein, vitamin C, thiamine, riboflavin, niacin and significant amount of dietary fiber. Other part of cocoyam plant such as the leaves, flowers and stems are also consumed especially in sauces, purees, stews and soups, depending on the varieties and the local cultural traditions (Ejoh*et al.,* 1996). Therapeutic benefits of the various part of the plant had also been reported by Tuse *et al.* (Tuse*et al.,* 2009).

However, cocoyam has not received any deliberate attention to address its research and development. It receives low research priority in all regional agricultural research centres and therefore, its contribution to food security and economy is underestimated. Consequently, there is pausity in information on cocoyam production, especially with regard to the prospects or constraints that would be favourable to or limiting sustainable cocoyam production, respectively in East Africa (Talwana*et al.,* 2009).

2.2 NUTRITIVE VALUE OF COCOYAM LEAF

Cocoyam is naturally a perennial crop, but for practical purposes may be harvested after 5 - 12 months of growth (Ogwu and Osawaru, 2015). Its growth and developmental cycle goes through three main periods. Immediately after planting, there is a rapid increase in shoot growth until about six months after planting.

Cocoyam ranks third in importance after cassava and yam among the root and tuber crops that are cultivated and consumed in rural areas by the elderly in Nigeria. The crop is no longer favoured in urban homes due to poor information about its nutritive values. This widespread ignorance of the nutritive value and diversities of food forms of cocoyam is a major problem for the general acceptability and extensive production of the crop (Okoye, 2007).There is a need to improve cocoyam use among consumers.

The main nutrient supplied by cocoyam, as with other roots and tubers, is dietary energy provided by its carbohydrate content. Its protein content is low 1-2%, and as in almost all root crop proteins, sulfur-containing amino acids are limiting. By contrast, cowpea protein is of higher value and can complement the deficiencies of cocoyam. In many countries, cocoyam leaves, petiole, and flowers can be eaten as vegetables (Seetohul*et al.*,2008).

Colocasia leaves are about 30 - 60 cm long and 45cm wide) and velvety soft to touch. The sagittate-ovate or peltate leaves of cocoyam arise alternatively from the main corm in a spiral kind of arrangement. The leaves grow out of the leave stalk of existing leaves just after the death of older, most matured and outermost leaves. This ensures that approximately the same amount/number of leaves are found on a Cocoyam plant at different times/period. The leaves are pigmented with marginal veins and central lobes.

Although cocoyam has good nutritional qualities, it is not a nutritionally complete food and cooking of some sort is almost always required to detoxify the corms and leaf parts, and to make them softer and physically palatable (Matthews, 2010). Taro leaf blades contain more protein than corms and are a good source of minerals and vitamins. It has been reported that leaves from Taro *(Colocosia esculenta)* are rich in vitamins and minerals. They are a good source of thaimine, ribloflavin / iron, phosphorus and zinc and a very good source of vitamin B6, vitamin C,niacin, and especially in the leaves, also it is highly perishable that is it has high content of water. Leaves of new cocoyam are also used in feeding pigs because of its nutritive values (Agrid, 2006)

Preliminary investigations have reveal that most vegetables are good source of antioxidants, but some are definitely much better than others. When it comes to vitamins, minerals, carotenoids and cruciferous phytonutrients, which are all virtually importable to good health, the most potent vegetable are dark green leafy vegetables, hence, this effort to fully investigate the nutritional, anti-nutritional and phytochemical characteristics of leaves of cocoyam.

Cocoyam leaf stems (petioles) are eaten but there is relatively little information on their nutritional qualities and use likewise the stolons and flower heads (inflorescences) especially in Southern China, Southeast Asia and the Pacific Islands (Matthews, 2010). It is a staple food for many people in developing countries in Africa, Asia and the Pacific. Essential amino acid contents are fairly good except for the Sulphur containing amino acids such as tryptophan and histidine (Huang *et al.,* 2007).

Cocoyam research and conservation efforts are gaining ground although limited information abounds about the amount and nature of diversity.

Cocoyam leaves are usually consumed by humans after heat treatments, such as boiling, blanching, steaming, stewing, frying and pressure cooking. These methods are found to be effective in improving digestibility, increasing nutrient bioavailability and also minimizing food-borne diseases (Lewu*et al.,* 2009). Though, boiling can help to reduce the oxalate content in the leaves (Noonan and Savage, 1999), it may also reduce the nutritional value of food crops arising from significant losses and changes in major nutrients during cooking (Lewu*et al.,* 2009). In the areas where this crop is cultivated in South Africa, attention has only been paid to the tubers and not the leaves. In other parts of the world, the leaves of ***C. esculenta*** have been reported to be rich in nutrients, including minerals and vitamins such as calcium, phosphorus, iron, vitamin C, thiamine, riboflavin and niacin (Baruah, 2002).

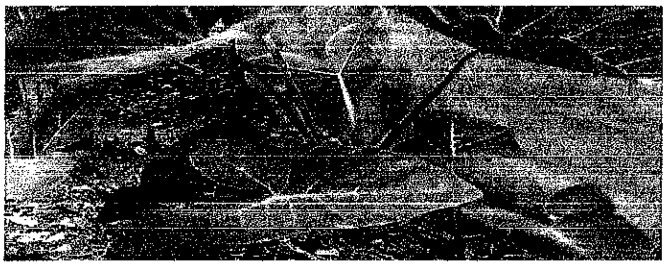

Plate 2: DIAGRAM OF COCOYAM LEAF

Source:https://upload.wikimedia.org/wikipedia/commons/b/be/Cocoyam%2C_leaves_are_edible_and_called_kontonmire.jpg

2.3 COCOYAM LEAF IN ANIMAL NUTRITION

The two most important nutrients required in animal nutrition are energy and protein. In Nigeria, energy and protein constitute about three-quarters of the total cost of formulated feed (Olomola, 2008). Many livestock farmers in Nigeria feed agro industrial by-products to their animals due to high cost of conventional feed ingredients (Iyayi*et al.,* 2003) Agro industrial by-products are however of low nutritive value, and non-conventional feed stuffs such as taro can be fed in place of agro-industrial by-products which are of low nutritive value. Two types of crops that share the name cocoyam are ***Xanthosoma sagittifolium*** and ***Colocasia esculenta*** (Dotsey, 2009). Taro has been said to have the potential of being used in ruminant nutrition (Babayemi, 2009). It has been fed to snails (Okon*et al.,* 2012); fish (Aderolu*et al.,* 2009); pigs (Agwunobi*et al.,* 2002 ; Ngo *et al.,* 2010); and poultry (Abdulrashid and Agwunobi, 2009; Ologhobo and Adejumo, 2011; Adejumo and Ologhobo, 2012).

The use of taro in animal nutrition is however limited by the presence of anti-nutritional factors such as tannins, saponins, oxalates, phytates, and hydrocyanide (Abdulrashidand Agwunobi, 2009; Olajide*et al.,* 2011). Processing techniques such as boiling or cooking, soaking, ensiling and drying have been shown to reduce the effects of these anti-nutritional factors on the animals (Adejumo andOloghobo, 2012; Olajide*et al.,* 2011; Onu and Madubuike, 2006).

Colocasia esculentais a cheaper carbohydrate source than grains (Onu and Madubuike, 2006; Adejumo, 2012). It has low production cost, high caloric yield per hectare and are not easily susceptible to pests and disease attack. Its major limitations in its use in animal nutrition are storage and the presence of anti-nutritional factors such as tannins, saponins, phytates, oxalates it contains. Some anti-nutritional factors serve as defense mechanisms against pests and diseases. For example, oxalates have been observed to play defense role in plant as well as storage reserve for calcium.

A toxicant is a substance which under practical circumstances can impair some aspect of animal metabolism and produce adverse biological or economic effects in animal product (Udeybir, 2008). Anti-nutritional factors are however described as substances in the diets which by themselves or their metabolic products arising in the system interfere with the feed utilization, thereby reducing production or affect the health of the animals. Toxicants can be classified based on their chemical properties of effect of their utilization on nutrients as alkaloids, glycosides (such as saponins, cyanogens), phenols (gossypol, tannins), mycotoxins, metal binding (oxalates) and proteins (protease inhibitors and haemoglutinins). The result of the study by (Chhay *et al.,* 2008) revealed an apparent reduced digestibility for pigs fed diets containing ensiled taro leaves as against the higher values recorded in the findings of (Pheng*et al.,* 2008). The variation was however attributed to the differences in fibre level of the energy sources used in the studies.

Studies on boiled taro cocoyam in the diets of weaned pigs carried out by (Agwunobi*et al.*, 2002) revealed that there was no significant difference in feed intake, weight gain and feed efficiency between the diets containing boiled taro corms. It was exactly opposite with the diets contained unboiled taro, especially at levels more than 50% replacement of maize. In another study by (Ngo *et al.*, 2010) feed intake, rate of live weight gain and feed conversion ratio were poorest in pigs fed fresh taro leaves and stem, better responses were obtained for pigs fed cooked taro leaves and stem, while the best results were obtained for those fed ensiled taro leaves and stem (Babayemi., 2009) observed that the energy content and proximate metabolisable energy content of ***Colocasia esculenta*** corms indicated that ***Colocasia esculenta***is a potential useful energy supplement in ruminant feeding. The result of a study carried out by (Okon., 2012) showed that sun- dried taro meal can replace maize up to 50% in the diet of ***Achatina achatina*** without adverse effects on reproductive traits. The authors however recommended that inclusion of taro in the diet of animals at higher levels should be processed. (Aderolu *et al.*, 2009) fed one hundred and forty juveniles of ***Clarias gariepinus*** with diets containing graded levels of raw and differently processed cocoyam corms at 25% and 50% substitution levels for maize meal. The result showed the mean weight gain, relative growth rate and specific growth rate had the highest value recorded for the control followed by those fed diet containing 25% boiled cocoyam. The least value was however recorded for those fed diet containing 50% of fermented cocoyam. The authors reported significant lower values for all blood parameters recorded in the raw cocoyam meal diet. The result indicated that fish fed with boiled cocoyam diet gained higher weight than those fed raw cocoyam diet. Adejumo and Ologhobo, (2012) reported that boiling of ***Colocasia esculenta*** resulted in an improvement over the raw in broiler finishers fed differently processed ***Colocasia esculenta,*** having no adverse effects on hematological parameters of the birds.

Abdulrashid and Agwunobi, (2009) recommended that proper processing of ***Colocasia esculenta*** meal will effectively replace maize in the diets of broiler finishers at 25% for raw sundried taro cocoyam meal and 50% for boiled sundried taro. It has also been observed that silage made from taro leaves and petioles replaced up to 60 % of rice bran in diets for growing ducks without any decrease in performance, growth and with positive effects on carcass quality (Nyugen, 2009). Also, boiled sun-dried taro cornels had been reported to replace up to 50 % of maize (8.4 % of the total diet) in the diets of Japanese quails (Okon, 2007).

However, Ologhobo and Adejumo, (2011) concluded that boiled peeled sundried taro meal can replace maize in the diets of broiler finishers at 100% inclusion level, without any significant adverse effects on the performance characteristics of the birds.

2.4 COCOYAM LEAF AND HEMATOLOGICAL PARAMETERS

Cocoyam leaves have been reported to be rich in nutrients including minerals and vitamins such as calcium, phosphorours, iron, vitamin C, thiamine riboflavin and niacin (Lewu*et al.*, 2009). Among various edible aroids commercially cultivated in India, *Colocasia esculenta* assume note-worthy dietary significance having multiple uses in the form of various culinary preparations of its corm and edible stem. Fresh edible leaves of *Colocasia esculenta* form rich source of protein, ascorbic acid, dietary fibre and some nutritionally important minerals. Tender leaves of *Colocasia esculenta* are used as vegetable. Leaf juice is applied over scorpion sting or in snake bite. It is also given in food poisoning of plant origin. Plant pacifies vitiated (Ayurveda identified ailments *viz.*) vata and pitta, constipation, stomatitis, alopecia, hemorrhoids and general weakness (Awasthi and Singh, 2000; Devarkar, 2011). *Colocasia antiquorum* is reported to possess heap to protective activity against experimentally induced liver injury in rats (Tuse*et al.*, 2009). *Colocasia esculenta* is reported to possess hypoglycemicefficacy due to the presence of cyanoglucoside (Phillip *et al.*, 2002). Hypolipidemic and antihyperlipidemic activity has been reported due to the presence of arabinogalactan (Boban, 2006) and mono and digalactocyldiacylglycerols (Tanaka, 2005). Also it possesses antifungal activity due to presence of cystatin (Yang, 2005). Antibacterial activity of *Colocasia esculenta* has been mentioned by Ravikumar and co-workers (Ravikumar, 2011)

Bhagyashree (2011)study support the traditional claim in both Indian and other ethnic medicinal systems that the leaves of *Colocasia*n *esculenta* possess antihepatotoxic and heap to protective efficacy.It is speculated that antihepatotoxic and heap to protective as well as antioxidant effects of the crude filtered juice of the *Colocasia esculenta* may be due to the presence of anthocyanins or some flavonoids.

2.5 ORIGIN AND DISTRIBUTION OF RICE

Rice is first mentioned in the Yajur Veda (c. 1500-800 BC) and then is frequently referred to in Sanskrit texts (Farooq, 2011). *Oryza sativa*, rice, is a genus of perennial grass in the Poaceae (grass family) that originated in India, Thailand, and southern China, was domesticated and diversified in ancient times, and is now cultivated in wet tropical, semi-tropical, and warm temperate areas around the world for the production of its cereal grain (Bernier, 2008). The earliest remains of cultivated rice in the Indian sub-continent have been found in the north and west and date from around 2000 BC. Perennial wild rice still grow in Assam and Nepal. It seems to have appeared around 1400 BC in southern India after its domestication in the northern plains. It then spread to all the fertile alluvial plains watered by rivers. Cultivation and cooking methods are thought to have spread to the west rapidly and by medieval times, southern Europe saw the introduction of rice as a hearty grain (Jeon, 2011). Today, rice is grown and harvested on every continent except Antarctica, where conditions make its growth impossible. The majority of all rice produced comes from India, China, Japan, Indonesia, Thailand, Burma, and Bangladesh. Asian farmers still account for 92-percent of the world's total rice production (Olsen, 2002).

Rice is the world's most important food cereal crop and a main food source for more than a third of the world's population (Khush, 1997). Rice *(Oryza sativa)* is a staple food in many countries of Africa and other parts of the world. This is the most important staple food for about half of the human race (Imolehim and Wada, 2000). Saka and Lawal (2009) classified rice as the most important food depended upon by over 50 percent of the World population for about 80 percent of their food need. Due to the growing importance of the crop, Food and Agricultural Organization (FAO2001) estimated that annual rice production should be increased from 586 million metric tons in 2001 to meet the projected global demand of about 756 million metric tones by 2030.

More than 90% of the world's rice is cultivated and consumed inAsia where 60% of the world's people live (Khush, 1997). Rice provide about35 to 60% of the calories consumed by 3 billion Asians (Khush, 1997). Rice grown on about 148 million hectares annually, or on 11% ofthe world's cultivated land (Khush, 1997). Rice is the only major cereal crop that is consumed almost exclusively by humans (Khush, 1997). Earth's rice. Research has shown that production and processing technologies have not been able to meet the increasing demand for rice (FAO, 2001). In the West African sub region, Nigeria has experienced a well established growing demand for rice caused by rising per capita consumption and consequently the insufficient domestic production had to be complemented with enormous import both in quantity and value at various times (Saka and Lawal, 2009).

Of the two breed species, Asian cultivated rice, Oryza sativa, is cultivated worldwide. Oryza glaberrima, the African grown rice, is planted on a limited scale in West Africa (Kole, 2006). Rice belongs to the grass family Gramineae (Kirk, 1998). The genus Oryza, to which grown rice belongs, may be originated at least 130 million years ago and dispersed as a wild grass in Gondwanaland, the super continent that eventually broke up and drifted apart to become Asia, Africa, Australia, and Antarctica (Kole, 2006). This shows the distribution of Oryza species all over the world except Antarctica (Kole, 2006). There are 22 wild species of genus Oryza, Nine of the wild species are tetraploid and the remaining wild species and the two cultivated species are diploid. The universal rice, Oryza sativa, and the African rice, Oryza glaberrima, are thought to be examples of directional evolution in crop plants (Kole, 2006).

2.6 DESCRIPTION AND PROCESS OF RICE STOVER

Rice stover is the vegetative part of the rice plant (*Oryza sativa* L.), cut at grain harvest or after. It may be burned and left on the field before the next ploughing, ploughed down as a soil improver or used as a feed for livestock (Kadam *et al.*, 2000). Rice stover is a major forage in rice-producing areas.

Rice stover or straw can be treated in order to improve its nutritive value. Those treatments are designed to enhance feed intake and/or digestibility. Improving digestibility may be achieved through mechanical, chemical, heat and pressure treatments. Chopping and grinding rice straw may reduce the time of passage in the rumen and improve feed intake. (Heuzé, 2015)

Chemical treatments (NaOH, ammonia, urea) may be hazardous to humans and animals (heavy urination, faster rumen washout).

NaOH treatment consists in soaking the straw in NaOH solutions, draining it and sometimes washing it after treatment. This may cause water pollution. It is also possible to spray NaOH onto the straw and then allowing it to dry.

Ammonia treatments are safer and provide nitrogen that is lacking in straw. Ammonia reduces physical strength and disrupts silicified cuticles in leaves. Ammonia treatments can increase digestibility by 31%.

Urea treatment is the easiest to apply. It can be done by smallholder farmers using plastic bags, with a 5% urea w/w solution. It can increase digestibility by 18% (Van Soest, 2006).

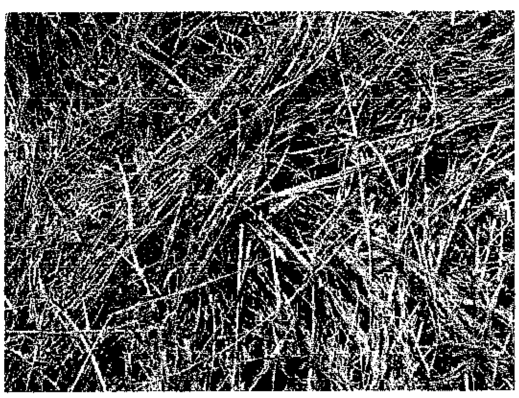

Plate 3: DIAGRAM OF RICE STOVER

Source:https://www.feedipedia.org/sites/default/files/images/oriza_sativa_rice_straw_06_0.jpg

2.7 NUTRITIVE VALUE OF RICE STOVER

The utilization of stover or straw through feeding and through the production of gas from the resulting dung is the most efficient system currently available. However, the efficiency of the livestock component could be considerably enhanced by applying presently known techniques, so that more animal products could be obtained from given quantities of straw than at present.

Rice straw contains less lignin than other straws but has a higher silica content. The leaves contain more silica than the stems (Van Soest, 2006).

It is, therefore, recommended to cut rice straw as short as possible to increase the proportion of stems (Van Soest, 2006). Silicas are cell-wall bound or soluble. They are excreted in the urine and some calculi may occur but this does not appear to be a serious problem.

Rice stover contains high levels of oxalates (1-2% DM), which are known to decrease the Ca concentration, making Ca supplementation necessary (Van Soest, 2006).

Stovers are a poor livestock feed, and rice straw is no exception. It contains about 80 percent of substances which are potentially digestible and are therefore sources of energy, but actual digestibility by ruminants is only 45 to 50 percent. Furthermore, the amount an animal can eat is limited to less than 2 percent of body weight because of the slow rate at which it is fermented in the rumen. The net result is an energy intake which provides little or no surplus energy for growth, work or production (Heuzé, 2015).

Moreover, the most important consideration in obtaining more animal products from straw in the Asian setting is to improve digestibility and intake so that more energy is available for productive purposes. Protein supplements increase intake, while the alkali treatment of straws increases digestibility and usually voluntary intake as well. The chemistry of straw and its digestion and the chemical changes caused by alkali treatment are receiving increasing attention from animal nutritionists. The quality of rice straw depends on many factors: variety, time between harvest and storage, N fertilization, plant maturity (lignin content increases with maturity), plant health and weather conditions (Drake *et al.*, 2002). Rice straw is a good source of energy, but is low in protein (2-7%) and its high silica content results in a low digestibility

(Drake *et al.*, 2002). It is considered as a low quality and variable roughage. Minerals (particularly sulphur) can be limiting factors (Heuzé, 2015).

2.8 RICE STOVER IN ANIMAL NUTRITION

When straws are fed to ruminants, the primary limitations to production are low overall digestibility, slow rate of passage in the rumen, low propionate fermentation pattern in the rumen, and low contents of fermentable N and by-pass protein.

Depending on the farming systems, there are several ways to feed ruminants with rice straw (Heuzé, 2015). In extensive systems, the animals are allowed to enter paddy fields after harvest and graze rice straw and weeds in the field or on the roadsides. In less extensive systems, the animals are tethered in the paddy field close to stacks of rice straw. In stall-fed systems, rice straw may be fed alone, or fed with other forage supplements and/or concentrates.

Rice straw fed alone proved to be sufficiently nutritious to feed draught cattle during short periods, but did not meet full animal requirements and had to be supplemented with crude protein and minerals, especially P and Ca (Heuzé, 2015)

In dairy cows fed rice straw, legume protein sources were found to have positive effects on DM intake (Oddoye *et al.*, 2002), milk yield and milk composition (Akbar *et al.*, 2000). Higher feed intake and rice straw digestibility may also be obtained when adding maize silage to rice straw (Liu XiaoHui *et al.*, 2006), or after chemical treatment of the straw. Those treatments (see Processes on the "Description" tab) improved rumen degradability, total digestible nutrients and N retention in cows (Heng Sheng *et al.*, 2002; Prasad *et al.*, 1998; Ha *et al.*, 1994). Combination of chemical treatments with grass or protein supplements also offers a wide range of improved diets for cows with positive effects on dairy *production* and feed costs (Wittayakun *et al.*, 2005; Oddoye *et al.*, 2002; Ngo Van Man *et al.*, 2001; Bhaskar *et al.*, 1992.

In dairy heifers, a combination of urea-treated rice straw with cottonseed cake resulted in optimal weight gain and the lowest feed costs. Rice straw mixed with rice bran and urea-molasses improved live-weight gain, weight of calves and milk yield (Hari Singh *et al.*, 2001).

In cows and heifers, ensiling rice straw was beneficial to daily milk yield (Chen XiLing *et al.*, 1995) and fat milk content (Ngo Van Man *et al.*, 2001). However, ensiling and fermentation needs caution because damp rice straw has lower DM and overall nutrients, is prone to moulds and possibly aflatoxin contamination in milk (Bhuiyan *et al.*, 2003).

In steers, chemical treatments of the rice straw were also shown to increase feed intake and animal performance (Nguyen Xuan Trach, 2004; Cardoso *et al.*, 2004).

Every treatment or supplementation of rice straw in sheep was reported beneficial on feed efficiency and animal performance (Kusmartono, 2007; Oddoye *et al.*, 2005; Premaratne *et al.*, 1998; Abdella *et al.*, 1998; Damasceno *et al.*, 2000; Orden *et al.*, 2000; Harada *et al.*, 1999; Rajeev Pradhan *et al.*, 1996). Only one trial reported a supplement of mature poplar leaves to have no beneficial effect on rice straw value (Paliwal *et al.*, 1993).

Ensiling rice stover with *Rumino coccusalbus* and *Clostridium cellulovorans* increased digestibility and nutritive value (El-Galil, 2008). *Lactobacillus plantarum* improved total digestible nutrients, digestible energy and dry matter intake (Xu Chun Cheng *et al.*, 2006). Other attempts were less successful: fermenting rice straw with *Flammulinavelutipes* had no effect on Hanwoo sheep intake or performance (Shinekhuu *et al.*, 2009). As mentioned above, ensiling rice stover with mature poplar leaves did not ensure sheep maintenance (Paliwal *et al.*, 1993).

2.9 RICE STOVER AND HEAMATOLOGICAL PARAMETERS

Rice straw is fibrous and amatively high lignocellulose (Leng, 1991). The enhanced DM digestibility driven by the improved fermentation activities of the rumen bacteria, especially cellulolytic strains appeared to increase by supplementing SC, which is capable to scavenge excess oxygen to create optimal environment for rumen anaerobic bacterial activities. Nevertheless, some of *S.cerevisiae* strains lack the ability to have stimulatory effects on rumen fermentation (Latif *et al.*, 2014).

Glucose metabolism is influenced by nutritional and physiological conditions of animals and reduced during heat exposure (Sarker*et al.,* 2017). Blood glucose is one of the most common metabolites used to assess the energy status of cattle (Ndlovu *et al.*, 2007).

It was found that numerical value of plasma glucose was higher for URS-diet than CL-diet. Cholesterol contains triglycerides and low-density lipoprotein (LDL-C), very low density lipoprotein (VLDL-C) and high-density lipoprotein (HDL-C). In this experiment, cholesterol, triglycerides, HDL-C and LDL-C were numerically lower for URS-diet than CL-diet in every case. HDL-C is tested to determine risk of developing heart disease (Thomas *et al.* 1997). HDL-C is helpful for recovery of cardiovascular diseases also. The percentage of URS replacement was not sufficient for altering significant variation between CL-diet and URS diet groups at all cases. Probably, higher percentage of URS-diet supplement will get positive output in URS-diet group. In ruminants, urea can be influenced by quantity of dietary protein, level of feed intake, and protein degradability in the rumen (Karnezos *et al.*, 1994).

Blood urea nitrogen level was found statistically non-significant in the study of Mustafa (Mustafa *et al.,* 2015). The BUN test is used to evaluate kidney function and to monitor the effectiveness of dialysis and other treatments related to kidney disease or damage. Though Urea level of blood showed no significant difference, numerically lower value in case of URS-diet found during the study period. Serum total protein is very important since it reflects the natural status of the animal and it has a positive correlation with dietary protein (Mustafa *et al.,* 2015). El Marakby (2003) cleared that there was no significant effect of feeding lambs on wheat straw treated with *Agaricusbisporus*spawning on plasma total protein values. Mean values of plasma globulins tended to be insignificantly higher for lambs fed rations containing treated wheat straw then those feed the control ration. This may be due to that rations containing treated wheat straw improved albumin synthesis in the liver. Obtained results are accordance with those obtained by Kholif*et al* (2005) and Alam*et al* (2006) who reported that biological treatments increased total of protein serum. They also reported that serum globulin was not affected by biological treatment. Gado*et al* (2006) Studied the values of blood serum total proteins and albumin for the animal fed rice straw treated with ZAD^R, fungus, ZAD^R + fungus and untreated. They found that blood serum total proteins and its fractions were within the normal values. So, these results approved that the microbiological treatment of poor quality roughages showed increase in their CP content digestibility when conditions are appropriate Khattab*et al* (2013).

2.9.1 HEAMATOLOGICAL PARAMETERS OF WAD GOAT

The West African dwarf goats are valuable anima lgermplasm, which has attracted many research efforts. Despite available information, only a few on-farm reports exist on the biological characterization of this breed. The significance of determining haematological and biochemical indices of domestic animals has been well documented and changes of these parameters have been studied in cattle, sheep, and Red Sokoto goats (Opara*et al.,*2010).

However, the life of all flesh is the blood and its usefulness for assessing the health status, chemical evaluation for survey, physicalogical pathological conditions and diagnostic and prognostic evaluation of various types of diseases in animals cannot be over emphasize (Alade., 2005). It also helps in distinguishing normal state form state of stress, which can be maturational, environmental or physical (Aderemi., 204)Haematological values are widely used to determine systematic relationship and physiological adaptation including the assessment of general health condition of animal (Kamal *et al.*, 2007).

Blood composition of animal might be influenced by certain factors such as nutrition, management, andgreat of animals, sex, age diseases and stress factors that might affect blood values. The hematological and geochemical indices are an index and reflection of the effects of dietary treatment on the animals in terms of the type and amount of feed ingested and were available for the animals to meet its physiological geochemical and metabolically necessities (Ewuola *et al.*, 2004)and also the level of anti-nutritional element of or factors present in the feed also influence the hematological and biochemical values (Akinmutimi, 2004)There is a great variation in the haematological and biochemical parameters as observed between breeds of goats (Tambuwal *et al* 2002) and in this regard it may be difficult to formulate a universal metabolic profile test for goats. These differences have further underlined the need to establish appropriate physiological baseline values for various breeds of livestock in Nigeria, which could help in realistic evaluation of the management practice, nutrition and diagnosis of health condition.

To meet the high demand for meat as a source of animal protein in the future, much of the increase in meat production would have to come from short-cycle animals which will require a little management practice to rear them. Examples are the domestic goat, sheep and other mini-livestock such as the grass-cutter. Blood is a specialized bodily fluid in animals that delivers necessary substances such as nutrients and oxygen to the cells and transport metabolic waste products away from those same cells. In vertebrates, it is composed of blood cells suspended in a liquid called blood plasma. Plasma, which constitute 55% of blood fluid, is mostly water (92% by volume) (Franklin institute, 2009) and contains dissipated proteins, glucose, mineral ions, hormones, carbon-dioxide (plasma being the main medium for excretory products transportation) and blood cells themselves. Blood performs many important functions within the body including: supply of oxygen to tissues (bound to haemoglobin, which is carried in red cells, supply of nutrients such as glucose, amino acids and fatty acids (dissolved in the blood or bound to plasma proteins e.g. blood lipids), removal of waste such as carbondioxide, urea and lactic acid, hydraulic functions and Regulation of core body temperature (Franklin institute, 2009).

Similarly, haematological and blood biochemical measurements may vary depending on factors such as sex, age, weather, stress, season, pregnancy status and physical exercise (Kaneko *et al.*, 1997). Significant changes in these parameters are used to draw inference in clinical investigation. Nottidge *et al.* (1999) reported significantly higher weaning percentage of lambs from haemoglobin types in Nigarili sheep, suggesting that haemoglobin genotypes may be related to some reproductive and productive traits in animals.

Haematological and biochemical indices of animals may give some insight as to their production performance potentials of the West African dwarf goats. Various reports (Nottidge *et al.*, 1999; Tambuwal *et al.*, 2002) have documented haematological and biochemical parameters of domestic species in Nigeria, only very few were on goats.

2.9.2 LEAFY VEGETABLES AND HEMATOLOGICAL PARAMETERS OF WAD GOAT

Protein supplementation is often important to improve livestock performance, and this needs to be done with respect to the requirements of the animal in addition to the balance of other nutrients available. However, the prices of these protein sources have been escalating continuously in recent times, whilst availability is often erratic. The problem has been worsened due to the increasing competition between humans and livestock for these protein ingredients as food.

According to Odunsi, (2003) the rapid growth of human and livestock population, which is creating increased needs for food and feed in the less developed countries, demand for an alternative feed resources must be identified and evaluated. The use of tree parts as alternative feed resources for ruminant livestock is becoming increasingly important in many parts of the tropics and sub-tropics (Silanikove, 2000; Melesse *et al.*, 2009).

The use of fodder trees and shrubs to solve the problems of low productivity in small ruminant production has been reported by (Paterson *et al.*, 1999; Makkar and Becker 1996; Aregheore, 2004). Some indigenous and a limited number of introduced species have been selected to serve as supplements to the low quality forage fed to these animals (Pezo *et al.*, 1991). Most of the trials in the Humid Zone of West Africa (HZWA) conducted by the International Institute for Tropical Agriculture (IITA) and the International Livestock Centre for Africa (ILCA) involved

Gliricidia sepium and Leucaena leucocephala which have shown benefits to crops production and animal improvement through alley farming and feed gardens. However, these species may have limitations in terms of productivity, palatability, presence of toxic substances and adaptability (Akinbamijo *et al.*, 2006). Also, the reluctance of smallholder farmers to adopt these tree species as supplements for small ruminant nutrition has necessitated the search for other tree species which may offer additional benefits.

One way of utilizing fodder trees is to use them as feed to small ruminants as part of, or along with, MultiNutrient Blocks (MNBs) (Sansoucy, 1995; Agbede and Aletor, 2004; Aye, 2007). MNBs create an effective ecosystem and increase intake and digestibility of low quality, high fiber grasses usually consumed by the small ruminants (Habib *et al.*, 1991).

Evaluation of the blood profile of animals may give some potentials of a dietary treatment to meet the metabolic needs of the animal since according to Church *et al.* (1984), dietary components have measurableeffects on blood constituents such that significant changes in their values can be used to draw inference on thenutritive value of feeds offered to the animals. The assertion of Ikhimoya and Imasuen (2007) that most of theavailable information on haematological parameters of goats in the humid tropics is based on disease prognosis.

The various functions of blood are made possible by the individual and collective actions of its constituents – the biochemical and haematological components. Generally, both the biochemical and haematological blood components are influenced by the quantity and quality of feed and also the level of anti-nutritional elements or factors present in the feed (Akinmutimi, 2004), including elements of toxicity. They can also be used to monitor protein quality of feeds. Hematological components of blood are also valuable in monitoring feed toxicity especially with feed constituents that affect the formation of blood (Oyawoye and Ogunkunle, 1998) reported that low level haemoglobin (Hb) of treatment diets could imply that dietary proteins were not of high quality. Diets containing poor protein would usually result in poor transportation of oxygen from the respiratory organs to the peripheral tissues (Roberts *et al.*, 2000). Reduction in the concentration of PCV in the blood usually suggests the presence of a toxic factor (e.g. haemagglutinin) which has adverse effect on blood formation (Oyawoyeand Ogunkunle, 1998). High WBC count is usually associated with microbial infection or the presence of foreign body or antigen in the circulating system. The haematological characteristics of livestock suggest their physiological disposition to the plane of nutrition (Madubuike and Ekenyem, 2006). Reductions in packed cell volume and red blood cell values are indicative of low protein intake or mild anemia. Blood chemistry constituents reflect the physiological responsiveness of the animal to its internal and external environments which include feed and feeding (Esonu *et al.*, 2001; Iheukwumere and Okoli, 2002). Blood chemistry studies are usually undertaken to establish the diagnostic baselines of blood characteristics for routine management practices of farm animals (Tambuwal *et al.*, 2002). The hematopoietic system is an important index of physiological and pathological status in animals and humans, since it is the one which becomes exposed to a high concentration of toxic agents first. Total serum protein has been reported as an indication of the protein retained in the animal body (Esonu *et al.*, 2001), while total blood protein depend on the quantity and quality of dietary protein. Normal range of blood sugar level indicates that animals are not surviving at the expense of body tissues (Ologhobo *et al.*, 1992).

2.10 Factors Influencing Haematological Parameters of Farm Animals

The genetic and non-genetic factors affecting haematological parameters of farm animals have been observed (Agaie & Uko, 1998; Kleinbeck & McGlorie, 1999; Svoboda, Eichlerova, Horak, & Hradecky, 2005; Xie *et al.*, 2013). Several factors including physiological (Alodan & Mashaly, 1999), environmental condition (Vecerek, Strakova, Suchy, & Voslarova, 2002; Graczyk, Pliszczak-Król, Kotonski, Wilczek, & Chmielak, 2003), dietary content (Odunsi, Onifade, & Babatunde, 1999; Yeong, 1999; Kurtoğlu, Kurtoğlu, Celik, Keçeci, & Nizamlioğlu, 2005; Iheukwumere and Herbert, 2002), fasting (Lamošová, Máčajová, & Zeman, 2004), age (Forlan, Macari, Malheiros, Moraes, & Malheiros, 1999; Seiser *et al.*, 2000), administration of drugs (Khan, Szarek, Koncicki, & Krasnodebska-Depta, 1994), anti-aflatoxin treatment (Oguz, Kececi, Birdane, Önder, & Kurtoglu, 2000) and continuous supplementation of vitamin (Tras *et al.*, 2000) affect the blood profile of healthy animal. Swenson (1970) and Addass, David, Edward, Zira, and Midau (2012) also observed that factors such as age, nutrition, health of the animal, degree of physical activity, sex and environmental factors affect blood values of animals. According to Daramola *et al.* (2005) age and sex of farm animals affect haematological parameters. Schalm, Jain, and Carroll (1975) reported that blood pictures of animals might be influenced by certain factors such as nutrition, management, breeds of animal, sex, age, diseases and stress factors. Dukes (1955) and Afolabi (2010) posited that haematological values of farm animals are influenced by age, sex, breed, climate, geographical location, season, day length, time of day, nutritional status, life habit of species, present status of individual and other factors. Carlson (1996), and Johnston and Morris (1996) reported that besides physiological and environmental factor that might affect blood values as: age of the animal, factors such as oestrus cycle, pregnancy and parturition, genetics, method of breeding, breeds of animal, housing, feeding, fasting, extreme climatic conditions, stress, exercises, transport, castration and diseases have been identified

TABLE 1: Haematological values of WAD and Red sokoto goats

Parameters	WAD	WAD (Daramola *et al* 2005)	RS (Tambuwal *et al* 2002)
	Normal range	Mean ± SE	Mean ± SE
PCV, %	21- 35	29.4 ± 0.9	25.7 ± 3.1
Hb, g/dl	7 – 15	9.8 ± 0.3	11.4 ± 1.6
RBCs, x10^6/ml	9.2 -13.5	11.5 ± 0.4	10.9 ± 2.1
MCHC, %	32 - 34.6	33.1 ± 0.1	44.7 ± 8.2
Total WBCs, x 10^3/ml	6.8 -20.1	13.5 ± 0.8	10.6 ± 2.8
LEUKOCYTES			
Lymphocytes, %	47 – 82	65.8 ± 1.1	51.6 ± 3.0
Neutrophils, %	17 – 52	33.5 ± 1.7	36.4 ± 2.5
Eosinophils, %	1 – 7	0.8 ± 0.2	3.9 ± 1.5
Monocytes, %	0 – 1	0.1 ± 0.0	7.4 ± 1.7

Source: Daramola J.O, Adeloye A.A, Fatoba T.A and Soladoye A.O ,2005. Haematological and biochemical parameters of West African Dwarf goats. Livestock Research for Rural Development, Vol.17 #8. Retrieved from: http://www.cipav.org.co/lrrd/lrrd17/8/dara17095.

NOTE: WAD=West African Dwarf Goat , RS =Red Sokoto Goat

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 LOCATION OF RESEARCH

The experiment was conducted at the Goat Unit, Animal Production and Health Departmental Teaching and Research Farm, Faculty of Agriculture, Federal University Oye-Ekiti with the GPS coordinates: latitude 7.8° N and longitude 5.2° E with average annual temperature of 24.2 °C and Rainfall of 177.800 cm per annum. Rain starts in March and stops in November.

3.2 EXPERIMENTAL ANIMALS

The experimental material comprises twenty (20) growing female WAD goats at different ages and body weights, purchased from the market and homes in Ikole-Ekiti. The animals were de-wormed and treated with appropriate acaricides. Each animal was randomly housed in individual well ventilated pen, equipped with feeding and watering troughs. Twenty Female West African Dwarf (WAD) Goat were used for the experiment. The goats were at different age and housed in individual pen. The building was cleaned fumigated and disinfected after which izar sumtin was sprayed. The surrounding of the pen house was cleared to discourage predators like ant and snake.

3.3 FEED STUFF AND DIET PRODUCTION

The variable feed ingredients used were palm kernel meal, rice stover, cocoyam leaf, rice husk, wheat bran and the fixed ingredients used are mono calcium phosphate, iodizes salt, premix in the experimental diet. The feed was mixed manually with the use of hand. A big sack was used on which the fixed ingredients were firstly mixed then the variable ingredient is weighed and added one by one and mixed together with the fixed ingredients. After this the variable ingredients and the fixed ingredients are thoroughly mixed together. Both the variable and fixed ingredients were weighed with electronic "x" scale.

3.4 EXPERIMENTAL DIETS

Three diets were used during experimental period (Table 2). Twenty WAD goats were randomly distributed into the four experimental groups one control and three diets in ratio: 4:6:5:5 to control: RS ; CL; RS+CL diets respectively. Thus each group has at least 4 replicates and a total 20 animals . They were fed with assigned experimental diets which were randomly assigned to animals. Animals on control diet of free range pasture were excluded from the supplemental feeding. The three experimental diets (Table 3) were randomly allocated to the animals. Each animal received 100g daily of an assigned diet for 90days. 14days Adjustment period was observed on each experimental diet .Portable drinking water was provided for each animal *ad libitum*. The feed left over was weighed and recorded to calculate for the weekly feed intake and this was done by substrating weekly left-over from cumulative daily feed given for the week.

TABLE 2 : COMPOSITION OF SUPPLEMENT DIETS (%)

Treatment diet	RS	CL	RS+CL
Palm kernel meal	10	10	10
Rice Stover	40	-	-
Cocoyam leaf	-	40	-
Rice Stover+ Cocoyam leaf	-	-	40
Rice husk	20	20	20
Wheat bran	27.25	27.25	27.25
Mono calcium phosphate	2	2	2
Iodized salt	0.5	0.5	0.5
Premix	0.25	0.25	0.25
Total	100	100	100

NOTE: RS= Rice Stover CL= Cocoyam leaf RS+CL= Rice Stover + Cocoyam leaf

TABLE 3; CONTROL AND SUPPLEMENTARY DIET PLAN

GROUP	(CONTROL)	RS	CL	RS+CL
Numbers of animals	4	6	5	5
Diet	Pasture browsing	Rice stover + Pasture browsing	Cocoayam leaf + Pasture browsing	Rice stover + cocoayam leaf + Pasture browsing
Diet quantity (kg/day)	Ad-libitum	0.1	0.1	0.1

NOTE: Animals assigned to supplementary diets were equally allowed on ad-libtum pasture browsing. RS= Rice stover CL= Cocoyam leaf RS+CL=Rice stover + Cocoyam leaf

TABLE 4; NUTRIENT COMPOSITION OF DIETS

COMPOSITION	CONTROL	RS	CL	RS+CL
Energy (kcal/kg)	-	3969.3	4207.3	4088.28
Crude protein (%)	-	0.88	1.60	1.24
Crude fibre (%)	-	27.37	20.37	23.8
Calcium (%)	-	0.66	0.54	0.60
Phosphorus (%)	-	0.79	0.76	0.85

Note: RS= Rice stover CL= Cocoyam leaf RS+CL= Rice stover + Cocoyam leaf

3.5 EXPERIMENTAL DESIGN AND STATISTICAL ANALYSIS

The experimental design adopted was Completely Randomized Design (CRD). Data generated were subjected to analysis of variance (ANOVA). Means and Tukey's procedures for means separation ($p<0.05$) using the software of Statistical Analytical System (SAS) version 8 of 1999

3.6 STATISTICAL MODEL

Statistical model for ANOVA

$Y_{ijk} = \mu + D_i + E_{ijk}$............ (1)

Y_{ijk}= Observation on ith diet, kth replicate

μ = General mean

ai = Effect of ith Diet (i =1, 2, 3, 4)

ε_{ijk} =Error containing all uncontrollable sources of variation NID $(0, \delta^2)$

3.7 BLOOD COLLECTION PROCEDURE

Blood samples were collected from the jugular vein of experimental animal. Five millimeter (5ml) of blood were collected from each goats and placed in plastic sample bottles containing ethylene diamine tetra-acetate (EDTA) as anti-coagulant for analysis. Haematological parameters analyzed from each sample includes Red blood Corpuscles (RBC), Haemoglobin concentration (HB), Packed cell volume (PCV), Mean Corpuscular haemoglobin (MCH) , Mean corpuscular volume (MCV) , Mean cell haemoglobin concentration (MCHC), Total white blood corpuscles (WBC) , Differential white blood count.

3.8 LABORATORY ANALYSIS

3.8.1 Enumeration of Red Blood Corpuscles

The total erythrocyte count was determined accurately by diluting a measured quantity of blood with a fluid isotonic solution by the method of Huxtable (1990).

Reagents

Red blood cell diluting fluid (Haymes fluid), 5g of sodium sulphate, 1 g of sodium chloride, 0.5 g of mercuric chloride were dissolved in 200 ml of distilled H2O.

Procedure

Blood was sucked exactly up to the 0.5 ml mark of the RBC pipette and the diluting fluid was drawn immediately up to the mark and the blood mixed thoroughly with the diluting fluid. It was left for 2-3 min for proper mixing. The Neubauer counting chamber was placed with its cover glass in position. The capillary stem of the pipette was emptied which contains only the diluting fluid. This was done by discarding the first 3-5drops.

Charging of the counting chambers

One drop of diluted blood was released into the groove of the Neubauer counting chamber. It was left for cells to settle for 2-3 min. The counting chamber was put under the microscope and the ruled area was located. Erythrocytes were counted in the 5 squares of the counting area of 1mm square. The number of cells in the 4 corner squares and one central square was counted.

Calculation

The average number of cells per square is multiplied by the factor 5000 to get estimate no. of cells in millions/mm3 of blood.

3.8.2 Enumeration of White Blood Corpuscles

The procedure of Raghuramulu et al . (1983) followed. WBC dilution fluid or Jurks fluid was used as the diluents. This fluid is potent to destroy RBC's.

Reagents

- WBC diluted fluid was prepared by mixing1.
- Glacial acetic acid2.
- 1% Gentian violet3.
- Water: 95 ml.

Procedure

The method of counting is similar to that of the RBC counting, except that the count is made in the 4 large (1mm) corner squares of Neubauer counting chamber.

Calculation

The average total no of cells in is multiplied by a factor of 200 to give the count /mm3 of blood.

3.8.3 Enumeration of Platelets

The procedure followed that detailed by Brecher and Cronkite (1964) .

Reagent

Platelet diluting fluid composed of Sodium citrate (3.8 g), formalin (0.2 ml) and brilliant cresol blue (0.1g) dissolved in 100 ml of distilled water and filtered before use.

Procedure

The dilution was done as described in RBC count. The counting chamber was charged as before and the numbers of cells in squares were counted as RBC counting was done.

Calculation

The total average number of cells in 5 squares was multiplied by factor 2000 to estimate the number of platelets /mm3 of blood.

3.8.4 Estimation of haemoglobin concentration (Hb)

The hemoglobin concentration was estimated by Acid - haematin method (Sahli, 2008). 0.1N Hydrochloric acid was taken up to 20 marks in a graduated tube. Blood was collected directly from the eyeball up to 20 cu mm in the Hb pipette and the outer side was wiped out and this was transferred into the graduated tube containing N/10 hydrochloric acid. This was allowed to stand for 10 to 20 minutes after thorough mixing. Then N/10 HCl was added drop by drop, mixing between each addition until the blood color matched with the standard color. And then the results.

3. 8.5 Estimation of packed cell volume (PCV)

PCV estimated by micro-hematocrit method (Schalm *et al.*, 1975). Blood sample was drawn into capillary tubes containing the anticoagulant, by capillary action to 2/3 of their length. The tubes were tapped to permit blood to flow towards the end and to provide sufficient space to prevent outflow when the opposite ends were sealed. The outside of the capillary tubes were wiped free of blood and the index finger was placed over the moist ends to hold the column of the blood in place as the opposite dry ends were forced into the sealing material to form a tight plug. The capillary tubes were placed in the centrifuge with the sealed ends pointing outward and centrifuged at 12,000 rpm for 5 minutes. PCV was determined by rolling the capillary tubes a reader card until the top of the plasma column was aligned with 100% line and the bottom of the packed erythrocytes was on the zero line. The line that crossed the top of the packed erythrocyte column represented the PVC in percent. Schalm, O.W., N.C. Jain and E.J. Caroll1975).

3.8.6 Estimation of Mean Corpuscular Volume (MCV)

This was the average volume of red cells. Because the size of the cell is very small, volume is expressed in cubic microns (μm3) (Mukherjee, 1988). It is calculated by using the following formula :

$$MCV = \frac{\text{Haematocrit (\%)} \times 10}{\text{R.B.C. count in millions}} \ \mu m^3$$

3.8.7 Mean Corpuscular Haemoglobin (MCH)

Mean Corpuscular Haemoglobin (MCH) is the average haemoglobin content of the red blood cell. MCH is influenced by the size of the cell and concentration of haemoglobin (Mukharje , 1988). It is derived by the formula:

$$MCH = \frac{\text{Haemoglobin (gram /100 ml)} \times 10}{\text{RBC in millions}} \text{ gm \%}$$

3.8.8 Mean Cell Haemoglobin Concentration (MCHC)

The MCHC is an expression of the average haemoglobin concentration per unit volume (100) of packed cells (W/V). Hence it is expressed in g/dilution which is the same as percent (%) (Mukharjee, 1988).

$$MCHC = \frac{MCH}{MCV} \times 100$$

3.8.9 WBC DIFFERENTIAL COUNT (Eosinophyl, Monocyte, Lymphocyte, Neutrophils)

They were counted and numbers determined under electron microscope.

CHAPTER 4

4.0 RESULTS

TABLE 5: Effect of cocoyam leaf and rice stover supplement diets on haematological parameters of young female West African dwarf WAD goats

Parameters	Pasture	RS	CL	RS +CL
Red blood corpuscles (*10/l)	6.46±0.92	5.26±0.44	6.31±0.51	6.04±0.53
Haemoglobin concentration (g/dL)	7.11±0.48	6.12±0.40	6.32±0.46	6.45±0.52
Packed cell volume (%)	0.23±0.01	0.19±0.01	0.18±0.01	0.20±0.02
Mean corpuscular haemoglobin (pg)	16.7±6.48	12.30±1.08	10.40±0.85	11.16±0.85
Mean corpuscular volume (fl)	56.13±23.58	37.30±3.33	31.64±2.23	35.50±3.27
Mean cell haemoglobin concentration (g/dl)	30.90±1.58	33.25±1.38	31.75±1.01	32.72±1.50
White blood corpuscles (*10/l)	14.91±1.80	14.34±1.11	15.05±1.86	12.20±1.56
WBC Differentials (%)				
Eosinophyls count (%)	10.22±2.53	7.00±0.86	11.00±1.80	10.55±1.62
Lymphocyte count (%)	43.00±4.35	46.47±2.85	38.10±3.78	43.63±2.26
Monocytes count (%)	8.67±0.82	7.88±0.63	7.40±0.43	8.00±0.27
Neutrophls count (%)	39.11±4.07	38.47±3.30	42.80±3.47	37.45±1.55
Plateletes count (%)	255.25±18.87	251.50±13.21	234.5±14.50	233.50±29.50

ab Mean± S.E on the same row having different superscript are significantly ($P<0.05$) different.

Note: RS= Rice stover diet, CL= Cocoyam leaf diet, RS + CL= Rice stover + Cocoyam leaf diet

Table 5 shows the haematological parameters of West African dwarf goats as affected by the control and supplement diets. Red blood cell (RBC) values for all diets and control were not significantly (p> 0.05) different. The RBC values obtained for goats on different diet groups range between (5.26 ± 0.44 and 6.46 ± 0.92.) The RBC was high (6.46) at control and low at (RS).

The Haemoglobin concentration (HB) values for goats on different all diet group range from 7.11± 0.48 to 6.12± 0.40 The HB value 7.11 was high on control and low on RS. Haemoglobin concentration (HB) values on all diets were not significantly (p>0.05) different

Packed cell volume (PCV) values for goats on the control and experimental diet were not significantly (p>0.05) different. The PCV values range from 0.23±0.01 and 0.18±0.01, PCV value was high on (control) and low on (CL).

Mean corpuscular volume (MCV) and Mean corpuscular haemoglobin (MCH) on all diets were not significantly (p>0.05) different. But values were high for both parameters on (control) and lower in (CL)

Mean cell haemoglobin concentration (MCHC) for values all diets and control were not significantly (p>0.05) different but the value was high on (RS) and low on (Control)

White blood corpuscles (WBC), for values all diets and control were not significantly (p>0.05) different. Result were high on (CL) and decreased in (RS+CL) The (WBC) range between 12.20±1.56 and 15.75±1.86 .

Eosinophils count, on all four diets were not significantly (p>0.05) different but was high on (CL) and low on (RS). The Eosinophil count range between (11.00±1.8 and 7.00±0.86).

Lymphocytes count, on control and experimental diets and control were not significantly ($p>.0.05$) different but was high on (RS) and decreased on (CL). The Lymphocyte count range was from 46.47±2.85 and 38.10 ±3.78 on control and experimental diets

Monocytes count, on all diets and control were not significantly ($p>0.05$) different but was high on (control) and decreased on (CL). The Monocyte count range between 8.67±0.82 and 7.4±0.43

Neutrophyls count, on diets and control were not significantly ($p>0.05$) different but was high on (CL) and low on (RS+CL). The Neutrophil count range between 37.45±1.55 and 42.80±3.47

Platelets count, on experimental diets and control were not significantly ($p>0.05$) different but was high on (control) and low on (RS+CL). The platelets count range between 255.25±18.87 and 233.50±29.50 .

CHAPTER 5

5.0 DISCUSSION

The nutrient composition of all diet is shown in table 4. The Crude protein, Crude fibre and Metabolisable energy of all diets met the physiological requirement for animals raised in tropical in environments Olomu, (1995).

The study reveals normal values of RBC (erythrocytic indices) which indicate that the cocoyam and rice stover leaf-based diets had no deleterious effect on the health status of the animals. Okwori *et al.*, (2016) reported that normal values of RBC (erythrocytic indices) perhaps indicate that the guava leaf-based diet had no deleterious effect on the health status of the experimental animals. RBC (erythrocytic indices).

HB values obtained were not significantly different in this study which agrees with Babayemi *et al.*, (2013) who reported that Haemoglobin (Hb) values of goats for his research were not significantly different (P>0.05), but were within the normal range reported for goats and also stated that the HB values in the study fell within the range of 7-15g/dl reported for clinically healthy WAD goats. WAD goats seem to possess relatively high HB values, and this is an advantage in terms of the oxygen carrying capacity Daramola *et al.*, (2005).

The variable result on PCV values across the treatment reveals that haematological trait especially PCV and HB were correlated with nutritional status of the animal. Likewise however, control had high HB and PCV values and this is as a result of the correlation between PCV and HB concentration and the primary functions of the erythrocyte are to serve as a carrier of haemoglobin. WAD goats have the tendency of compensatory accelerated production (CAP) of PCV in case of infection Daramola *et al.*, (2005). In this study RS, CL and RS+CL had a low

PCV value (20-18%) which implies that WAD goats in this study had no infection and are clinically healthy. PCV is essential in assessing protein status and forecasting the degree of protein supplement by goats. Daramola et al., (2005). In this study CL and RS based diets had a low PCV value 18 and 19% while RS+ CL is at normal range.

Mean corpuscular volume (MCV) and Mean corpuscular haemoglobin (MCH) shows no significant difference, but were within the range for goat reported by (Babayemi et al.,2003). Very high value on animals on control and low in animals on (CL) cocoyam leaf supplement diet. Very high MCV values indicate regenerative anaemia due to hemolysis and haemorrhages. However higher MCV values indicate macrocytosis. Samira *et al.,(*2016)

Mean corpuscular haemoglobin concentration (MCHC) values obtained in this study shows little variation and MCHC indicate macrocytic and hypochronic anaemia probably due to the increased activity of bone marrow and deficiency of some hemopoietic factors. MCHC is very significant in the diagnosis of anaemia and also serve as a useful index of the capacity of bone marrow to produce red blood cells and higher MCHC values was recorded animals (control) and low values was recorded in animals on (D3) which are the animals on cocoyam leaf supplement diet.

The Total white blood cells obtained were not significantly different for all treatments in this study. However, there are numerical differences. The higher values obtained in this study suggest well develop immune system and higher WBC was recorded for animals on (D2) Cocoyam leaf supplement diet. It was reported that, like other ruminants there are more lymphocytes than Neutrophils in circulation. The result also reveals non-significant effect on diet which indicates that the diet has little or no effect on the health status of the animal .This is in agreement with the result of (Okwori *et al.*, 2016), who reported that although there was numerical difference in white blood cell count (WBC) of the control and treated goats obtained, the values were not significantly different. . The variation might be due to differences in feeding regimen and management. However, the results for WBC in this study were within the range as reported for clinically healthy WAD goats by Daramola *et al.*, 2005; Ogunleke *et al.*, 2014. The values were higher compared to the range reported by Ukanwoko *et al* (2013) in WAD goats fed oil palm leaf meal–cassava peel based diets.

The white blood cell differentials (lymphocytes and neutrophils) in goats like other ruminants there are more lymphocytes than neutrophils in circulation DeRitis *et al.*, (2001). Lymphocytes are the key elements in the production of immunity.

The values of lymphocytes obtained in this study agrees with the values of Daramola *et al.*, (2005), Tambuwal *et al.*, (2002) and Okwori *et al.*, (20160, reported for WAD goats.

The value for Eosinophil in this study shows little variation but the result recorded in this study was high above the normal range (1-7) and higher than the recorded values from (Daramola *et al.*, 2005, Tambuwal *et al.*, 2002). Eosinophil release proteins cytokines and chemokines that produce inflammation but are capable of killing invading organism. Higher values obtained in this study might be due to infection of parasitic worms since Eosinophil release toxin to kill worms and it also indicates that the animals are healthy. Higher value was seen in animals on (CL).

The value for neutrophils was higher for (D2) Cocoyam leaf supplement diet. Neutrophils was observed to be a very effective killing machine of foreign bacteria and help in animal health by phagocytizing bacteria. High value indicates that the animals are healthy.

Platelets obtained were not significiantly different across all treatments. This agrees with the result of Kalio and Anyanwu, 2016 who reported that there was no significance in result of platelets of WAD does fed with different crop by-products.

CHAPTER 6

6.0 CONCLUSION

It is concluded from result of this study that cocoyam leaf + rice stover supplements in diets could be use to feed goat during the period of its abundance after harvest without any deleterious effect on the animal.

6.1 RECOMMENDATION

Other processing methods should be used in further studies to process Rice stover and Cocoyam leaf and test at various combinations in diets. The duration study can also be prolonged from three months to six to study effect on pregnant animals.

REFERENCES

Abdulrashid M, and Agwunobi L.N. Taro cocoyam (2009) (Colocasia esculenta) meal as feed ingredient in poultry. *Pakistan Journal of Nutrition.* 2009;8(5):668-673.

Adejumo I.O, and Ologhobo A.D. (2012). Haematological response of broiler finishers fed differently processed taro cocoyam (Colocasiaesculenta [(L.) Schott]. Agricultural TropicaEtSubtropica. 2012;45(3):112-116.

Aderemi, F.A (2004). Effects of replacement of wheat bran with cassava root sieviate supplemented of unsupplemented with enzyme on the Haematology and serum biochemistry of pullet chicks. Trop. J. animal Sci. 7:147-153

Aderolu A.Z, Lawal M.O, and Oladipupo M.O. (2009) Processed cocoyam tuber as carbohydrate source in the diet of juvenile African catfish (Clariasgariepinus). European Journal of Scientific Research. 2009;35(3):453-460.

Agbede J.O and Aletor V.A (2004). Chemical Characterization and protein quality evaluation of leaf protein concentrates from Gliricidiasepium and Leucaena leucocephala. J. Food Sci. Technol. 39: 253-261.

Agwunobi L.N, Awukam P.O, Cora O.O, and Isika M.A. (2002)Studies on the use of Colocasia esculenta(tarococoyam) in the diets of weaned pigs. Tropical Animal Health and Production. 2002;34:241-247.

Akinbamijo O.O Adediran S.A, Nouala S and Seeker J (2006). Moringa fodder in ruminant nutrition in the Gambia. Trees for life journal – a forum on beneficial trees and plants. Publication of International Trypanotolerance Centre, Banjul T retrieved on 6/10/2017.

Akinbamijo O.O, Adediran S.A, Nouala S and Saecker J (2004). Moringa fodder in ruminant nutrition in The Gambia. International Trypanotolerance Centre, Banjul the Gambia.

Akinlade J.A., Farinu, G.O., Olujide, A.M., Ojebiyi O.O., Aderinola, O.A. and TogunV.A. (2005), Evaluation of shrubby legumes (stylosanthesguinensis and stylosanthesscabra and cotton seed cake on the performance of West African Dwarf sheep, Proceedings of 10th Annual Conference of Animal Science Association of Nigeria (ASAN), University of Ado Ekiti, Nigeria. Sept 12 – 15, 2005, pp. 184 – 186.

Akinmutimi, A.H (2004). Evaluation of sword bean (Canavalia gladiate) as an alternative feed resources for broiler chickens. PhD thesis Micheal Okpara university of Agriculture, Umudike, Nigeria A.O. A.C, 1990 Association of Official Analytical chemists. Methods of Analysis 15th Edition Washington D.C.

Alade, A. A., Bambose, A. M. Ogutona, E.B. and Fanimo, A.O. (2005). Heamatological parameters, serum metabolites carcass characteristic of weaner Rabbits fed yam feel meal diets. Proceedings of 10th annual conference of Animal science Association of Nigeria

Allam, S. M., El-Hosseiny, H. M., Fadel M, El-Banna, H. M., Refai, A. R., (2006), Nutrients utilization and growth performance of lambs fed rations containing corn stover treated chemically and biologically., Agric. Sci., Mansoura Univ.,31, 1993 – 2007.

Acevedo-Rodríguez P, Strong M.T, (2005). Monocots and Gymnosperms of Puerto Rico and the Virgin Islands. Contributions from the United States National Herbarium, volume 52:415

Acevedo-Rodríguez P, Strong M.T, (2012). Catalogue of the Seed Plants of the West Indies. Smithsonian Contributions to Botany, 98:1192 pp. Washington DC, USA: Smithsonian Institution. http://botany.si.edu/Antilles/WestIndies/catalog.htm

Awasthi C.P and Singh A.B, (2000) 'Nutritional quality evaluation of edible leaves of some promising Colocasia and Alocasia collections',Ind J Agric Res.34(2): 117-121

Aye P.A (2007). Production of multi-nutrient blocks for ruminants and alcohol from waste products of Leucaena gliricidia leaves using local technologies. PhD Thesis, Federal University of Technology Akure.

Babayemi, O.J., Bamikole, M.A., Daniel, I.O, Ogungbesan, A., and Oduguwa, B.O. (2003) Degradability of three Tephrosia species, *Nigerian Journal of Animal Production* 30:62-70.

Babayemi O.J, Bankole M.A. (2009) Nutrient value and in vitro gas production of African wild cocoyam (Colocasiaesculentum). *African Journal of Food, Agriculture, Nutrition and Development* 2009;9(1):593-607.

Barbier, E.B., Acreman M. and Knowler D. (1997). Economic Valuation of Wetlands: A guide to Policy Makers and Planners. Ramsar Convention Bureau Gland, Switzerland.

Bhagyashree R.P, and Hussein M.A (2011) Antihepatotoxic Activity Of Colocasia Esculenta Leaf Juice. Faculty of Medicine, Jazan University, Jazan, Saudi Arabia International Journal of Advanced Biotechnology and Research ISSN 0976-2612, Vol 2, Issue 2, June 2011, pp 296-304http://www.bipublication.com

Boban, P., Nambisan, B. and Sudhakaran, P. (2006) Hypolipidaemic effect of chemically Different mucilages in rats: A comparative study *British Journal of Nutrition*, 96:10211029

Bobek P, O Ozdin and Mikus M (1995). Dietary oyster mushroom (Pleurotusostreatus) accelerates plasma cholesterol turnover in hypercholesterolemia rats. Physiological Research 44: 287-291.

Carney J.A, and Rosomoff R.N, (2009). In the Shadow of Slavery: Africa's Botanical Legacy in the Atlantic World. Berkeley, California, USA: University of California Press, 280.

Chhay T.Y, Khieu B, Preston T.R, Mea S. (2008) Intake, digestibility and nitrogen retention by growing pigs fed ensiled or dried taro (Colocasia esculenta) leaves as the protein supplement in basal diets of rice bran/broken rice or rice bran/cassava root meal. Livestock Research for Rural Development. 2008;19(9). Available: http://www.lrrd.org.

Chukwu G.O and Nwosu K.I (2008) Cocoyam rebirth. The renaissance of giant crop.Paper presented at the 17th Annual conference of Nigeria rural sociological Association at NRCRI Umudike. p: 11.

Church J.P, Judd J.T, Young C.W, Kebay J.L and Kin W.W (1984). Relationships among dietary constituents and specific serum clinical components of subjects eating self-selected diet. *American Journal of Clinical Nutrition*, 40: 1338-1344.

Dairo, F.A.S. So. K Fajemilehin and Onobi G.E (Eds) held on 12-15 September at University of Ado-Ekiti, Nigeria.pp: 280-282

Devarkar V.D., Marathe V.R., and Chavan D.P., (2011) 'Dietary and medicinal significance of wild vegetables from Osmanabad region, Maharashtra (India), Life Sciences Leaflets 11:317-332

Dotsey P.(2009) The use of cocoyam, cassava and wheat flour composite in the production of rock cakes, HND dissertation, Cape Coast Polytechnic, Cape Coast, Ghana. 2009;1:7-40.

Ejoh A.R, Mbiapo F.T, and Fokon E (1996) Nutrient composition of the leaves of and the fruits of Solanummelongena. Plant food for human nutrition 49: 107-112.

El-Marakby, K. M. A., (2003) Biological treatments of poor quality roughages and its effect on productive performance of ruminants, M.Sc., Thesis. Animal Production Department, Faculty of Agriculture, University Zagazig, Egypt.

Esonu B.O, Emenelom O.O, Udedibie A.B.I, Herbert U, Ekpor C.F, Okoli I.C and Iheukwumere F.C (2001). Performance and blood chemistry of weaner pigs fed raw Mucuna (Velvet bean) meal. Trop. Anim. Prod. Invest, 4:49-54.

Ewuola E.O., Falayan O.A, Cibore, F.A., Adebunmi, A.I Akanji R.A., Ogunlade J.T. and Adeneye J.A (2004). Physiological response of growing west African Dwarf goats fed groundnut shell-based diets as concentrate supplements. BOWEN J. Agric 1 (1):61-69

FAO,2013.FAO Species profile:Xanthosomasagittifolium.http://www.fao.org/docrep/T0646E/T046E0o.htm

Fasae, O.A and Alokan J.A., (2006). Growth performance of weaner Yankasa sheep fed varying levels of Leucaena leucocephala leaf residues. ASSESS SERIES A6 (2):323-328.

Fasae, O.A, Adu, I.F. Aina, A.B. J and Ekemo, K.A. (2009). Effects of defoliation time of maize on leave yield, quality and shortage of maize leaves as dry season forage for ruminant production. *Brazillian Journal of Agricultural Sciences* 4(3):358 – 362.

Gado, H. Nasr, S. A., Mohamed, B. K., Mahrous, A. A., (2006), Effect of biological treatments on the nutritive value of rice straw., Egyptian .J. Nutrition and Feeds., 9, 207-219.

Giacometti, D.C. and J. Leon, 1994. Tannia, yautia (Xanthosomasagittifolium). Plant Prod. Protect. Series, 26: 232-258

Govaerts R, (2013). World Checklist of Araceae. Richmond, UK: Royal Botanic Gardens, Kew. http://apps.kew.org/wcsp/

Habib W, Basir A.S, Wahidullah W and Ghuftrnullah (1991). The importance of urea – molasses blocks and by-pass protein in Animal Production. The situation in Pakistan, 135–145

H.A.L. Talwana, A.K. Serem , B.K. Ndabikunze, J.O.M. Nandi,R. Tumuhimbise, T. Kaweesi, E.C. Chumoand V. Palapala Production Status and Prospects of Cocoyam (Colocasiaesculenta (L.) Schott.) in East Africa. Journal of Root Crops, 2009, Vol. 35 No. 1, pp. 98-107 Indian Society for Root Crops ISSN 0378-2409

http://www.cabi.org/isc/datasheet/17221 (Date retrieved 05 - 09 - 2017)

Iheukwumere F.C and Okoli I.C (2002). Preliminary studies on raw NapoleanaImperialis as feed ingredient . 1: Performance and blood chemistry of weaner rabbits. Trop. Anim. Prod., 5: 100-110.

Ikhimioya I and Imasuen J.A (2007). Blood profile of West African dwarf goats fed Panicum maximum supplemented with Afzelia africana and Newbouldialaevis. *Pakistan Journal of Nutrition,* 6: 79-84.

Iyayi E.A, Okoruwa V.O, Babayemi O.J, Busari A.A, Peters O.F. Livestock production pattern of agro pastoralists in peri-urban centres of Southwest Nigeria. *Nigerian Journal of Animal Production.* 2003;30(1):87-92

Kamal Shah M., A. Khan, F. Rizvi, M. Siddique and Sadeeq-ur-rehman. (2007). Effect of cypermethrin on clinic Haematological parameters In Rabbits. Pauistanvet J. 27(4):171 175..

Kaneko J, Harvey J, Bruss M. (1997). Clinical Biochem of Domestic Animals. 5th Ed. Academic Press, New York, 932pp toxicologicas para substa'nciaspsicoativas.Revista de psiquiatriaclinica 27:509-56.

Karnezos T.P, Matches A.G, Preston R.L and Brown C.P (1994). Corn supplementation of lambs Grazing alfalfa. *Journal of Animal Science* 72: 783-789.

Khattab, H. M., Gado, H. M., Salem, A. Z. M., Camacho, L. M., El-Sayed, M. M., Kholif, A. M., El-Shewy, A. A., Kholif, A. E., (2013), Chemical composition and in vitro digestibility of Pleurotusostreatus spent rice straw., Animal Nutrition and Feed Technology., 13 173-182.Copyright © 2015 Science line Publication *Online Journal of Animal and Feed Research* Volume 5, Issue 2: 50-61; Mar 25, 2015

Kholif, A. M., El-Ashry, M. A., El-Alamy, H. A.,. -El-Sayed, M. Fade,l and Kholif, S.M.,(2005), Biological treatments of banana wastes for feeding lactating goats., Egyptian. J. Nutrition and Feeds., 8(2), 149 -162.

Langeland K.A, Cherry H.M, McCormick C.M, and Craddock Burks K.A, (2008). Identification and Biology of Non-native Plants in Florida's Natural Areas. Gainesville, Florida, USA: University of Florida IFAS Extension.

Latif, M.R., Zahran, S.M., Ahmed, M.H.,.Zeweil, H. S., and Sallam, S. M, A., (2014), Effect of

Feeding Saccharomyces cerevisiae and/or Aspergillusoryzae on Nutrient Utilization and Rumen Fermentation Characteristics of Sheep., Alex. J. Agric. Res.,59, 121-127.

Leng, R. A., (1991), Application of biotechnology to nutrition of animals in developing countries.,Rome, © FAO 1991. ISBN 92-5-103035-9. Univ., new England, Armidan, NSW, Australia

Lewu, M.N., Adebola, P.O. and Afolayan, A. J.(2009) ' Effect of cooking on the Proximate composition of the leaves of some accessions of Colocasia esculenta(L.) Schott in KwaZuluNatalprovince of South Africa' *African Journal of Biotechnology* 8(8), 1619-1622

Lyj and Preston T. R (1997). Estimation of washing losses in leaves Nigeria food journal 38:297-303. 54:271-283. Dietary need absorption, Seminar, PP21-24.

Madubike F.N and Ekenyem B.U (2006). Haematology and Serum Biochemistry Characteristics of Broiler Chicks fed varying Dietary Levels of Ipomoea Asarifolia leaf meal. Int. J. Poult. Sci. 5: 9-12

Mafabi, P. 2000. The role of wetland policies in the conservation of waterbirds: the case of Uganda. Ostrich, 71: 96-98.

Makkar H.P.S and Becker K. (1996). Nutritional value and anti-nutritional components of whole and ethanol extracted Moringa oleifera leaves. Animal Feed Science and Technology, 63 (1-4): 211-228.

Makkar H.P.S and Becker K. (1997). Nutrients and anti-quality factors in different morphological parts of the Moringa oleifera tree. Journal of Agricultural Science, (128): 311-322.

Manner H.I,(2011). Farm and forestry production and marketing profile for Tannia (Xanthosoma spp). In: Specialty crops for Pacific Island Agroforestry [ed. by Elevitch, C. R.]. Holualoa, Hawaii, USA: Permanent Agriculture Resources (PAR), 1-16.

Matthews, P. J. (2010). Earliest uses and cultivation of taro. In: Rao, R. V., Matthews, J. P., Eyzaguirre, P.B. andHunter, D, (eds). The Global Diversity of Taro Ethnobotany and Conservation. Bioversity International,Rome, Italy. 6-8pp.

M. C. Agrid (2006):"Minerals: Dietary transport and excretion" Workshop Seminar,

Melesse A, Bulang M and Kluth H (2009). Evaluating the nutritive values and in vitro degradability characteristics ofleaves, seeds and seedpods from M. stenopetala. J. Sci. Food Agr, 89: 281-287.

MRA Redo, NC Sarker, MT Kamaland M Al-Mamun (2017). Effect of used rice straw of mushroom cultivation on growth performance and plasma metabolites in beef cattle Animal Nutrition, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh;Mushroom Development and Extension Centre, Department of Agricultural Extension,

Mustafa M. ELmoghazy, Husain M. El-Fadaly, Tag EL-Din H. Tag EL-Din, Hamada A. Areda, Effect of Sheep Diets Containing Microbiological Treated Rice Straw on Blood Parameters and Nitrogen Balance, Correspondence to: Hamada A. Areda, Agric. Animal Production Dept., Fac. of Agric., Damietta University, Damietta, Egypt.2015; 5(2): 46-56 doi:10.5923/j.microbiology.20150502.02

Ndaruga A.M and P.R. Irwin (2003). Cultural Perceptions of Wetlands by Primary School Teachers in Kenya. International Research in Geographical and Environmental Education, 12: 219 – 230

Ndlovu T, M Chimonyo, A.I Okoh, V Duchene, K Dzama and J.G Raats (2007). Assessing the nutritional status of beef cattle: current practices and future prospects. African Journal of Biotechnology 6: 2727-2734.

Ngo HuuToan, Preston TR. Taro as a local feed resource for pigs in small scale household condition. Livestock Research for Rural Development. 2010:22(8). Available: http://www.lrrd.org

Nguyen TuyetGiang, Preston TR, Ogle B. Effect on the performance of common ducks of supplementing rice polishings with taro (Colocasiaesculenta) foliage. Livestock Research for Rural Development. 2009;22(10).

Nottidge HO, Taiwo VO, Ogunsanmi AO. (1999). Haematologicalanserum biochemical studies of cats in Nig. Trop. Vet. 17:9 – 16

Noonan S, Savage GP (1999). Oxalate content of food and its effect on humans, Asia Pacific J. Clin. Nutr. 8(1): 64-74.

Odunsi, A. A., 2003. Assessment of lablab (Lablab purpureus) leaf meal as a feed ingredient and yolkcolouring agent in the diet of layers. Int. J. Poult. Sci., 2 (1): 71-74

Ogwu, M.C and Osawaru, M.E (2015)Soil Characteristics, Microbial Compostion of Plot, Leaf Count and Sprout Colocasia [Schott] and Xanthosoma[Schott], Araceae) Collected in Edo State, Southern Nigeria, Department of Plant Biology and Biotechnology, Faculty of Life Sciences, University of Benin City, Nigeria http://dx.doi.org/10.4314/star.v4i1.57522(Print) and 2305-3372 (Online) Science, Technology and Arts Research Journal March 2015, 4(1): 34-44 . http://www.starjournal.org/

Okon BI, Obi MB, Ayuk AA. Performance of quails(2007) (Coturnixcoturnix japonica) fedgraded levels of boiled sun-dried taro cocoyam (Colocasia esculenta) as a replacement for maize. Agricultural Journal, 2007; 2(6):654-657.

Okon B, Ibon L.A, Nsa E.E, Ubua J.A(2012). Reproductive and growth traits of parents and F1 hatchings of Achatinaachatina(L.) snails under mixed feeding regime with graded levels of swamp taro cocoyam (Cyrtospermachamissonis) and pawpaw leaves (Carica papaya). Journal of Agricultural Science. 2012; 4(11):289-298.

Okoye B.C, Asumugha G.N, Onyenweaku C.E (2007). Economic Efficiency of Small-Holder Cocoyam Farmers in Anambra State, Nigeria: A Translog Stochastic Frontier Cost Function Approach. Agricultural Journal (Medwell Online) 4: 535-541.

Olajide R, Akinsoyinu A.O, Babayemi O.J, Omojola A.B, Abu A.O, Afolabi K.D. (2011) Effect of processing on energy values, nutrient and anti-nutrient components of wild cocoyam (Colocasiaesculenta(L.) Schott) corm. Pakistan Journal of Nutrition, 2011;10(1):2934.

Olaleye L.D, Owolabi B .J, Adesina A.O (1997) Nigeria Effect of cooking on wilted leaves". Journal 23:9-17,1997 Department of Chemistry, Federal University of Technology, P.M.B 704, Akure, Ondo State, "An approach to leaves of tropical tree". Chemical Composition of Red and White Cocoyam (Colocosia esculenta) Leaves

Ologhobo A.D, Adejumo I.O. (2011) Effects of differently processed (Colocasia esculenta [(L.) Schott)on growth performance and carcass characteristics of broiler finishers. International Journal of Agric Science. 2011;1(4):244-248.

Olomola O.O, Babayemi O.J, Akinsoyinu A.O. (2008) Performance characteristics and nitrogen utilization of pregnant West African dwarf goats fed groundnut cake, urea and rumen epithelial wastes in cassava flour and citrus pulp-based diets. Tropical and Subtropical Agro Ecosysytems. 2008; 8(1):61-67.

Onokpise, O.U., J.G. Wutoh, X. Ndzana, J.T. Tambong and M.M.,(1999). Evaluation of Cocoyam Germplasm in Cameroon. In: Perspective of New Crops and New Uses, Janick, J., (Ed.). ASHS Press, Alexandra, VA., pp: 394-396.

Onu P.N. Madubuike F.N. (2006) Effect of raw and cooked wild cocoyam (Caladium bicolor) on the performance of broiler chicks. Agricultura Tropical Et Subtropica. 2006;39(4):268 271.

Onwueme, I.C. (1994). Tropical root and tuber crops - Production, perspectives and future prospects. FAO Plant Production & Protection Paper 126, FAO, Rome.

Oyawoye E.O and Ogunkunle M (1998). Physiological and biochemical effects of raw jack beans on broilers. Proceedings of annual Conference of Nigerian Society of Animal Production, 23: 141-142.

Opara, M.N., Udevi, N. and Okoli, I.C. (2010).Haematological Parameters and Blood Chemistry Of Apparently Healthy West African Dwarf (WAD) Goats in Owerri, South Eastern Nigeria. New York Science Journal. 3(8):68-72.

Paterson R.T, Kiruiro E and Arimi H.K (1999). Calliandracolothyrsus as a supplement for milk production in the Kenya Highland. Tropical animal Health and Production, 31: 115–126.

Pheng B, Ogle R.B, Preston T.R, Khieu B. (2008) Digestibilty and nitrogen balance studies in pigs fed diets with ensiled taro (Colacasia esculenta) leaves as replacement for fish meal. Livestock Research for Rural Development. 2008; 20 (supplements).

Phillip, B. A., Grindleya, O. F., Asemotaa, H. N., Errol, Y. &Morrisona, A. (2002) Carbohydrate digestion and intestinal ATPases in streptozotocin-induced diabetic rats fed extract of yam (Dioscorea cayenensis) or dasheen (Colocasia esculenta), Nutrition Research, 22: 333–341.

PIER, 2013. Pacific Islands Ecosystems at Risk. Honolulu, Hawaii, USA: HEAR, University of Hawaii. http://www.hear.org/pier/index.html

Thomas CL, Editor (1997). Taber's CyclopedicMedicalDictionary. FA Davis Company, Philadelphia, PA [18th Edition].

Tuse T.A., Harle U.N., Bore V.V., (2009)'Hepatoprotective activity of Colocasiaantiquorum against experimentally induced liver injury in rats' Malyasian J pharma sci, Vol 7, No. 2, 99-112

Udeybir S.C, Niranjan P.S, Sanjay K. Handbook of General Animal Nutrition. Global Media Publisher. 2008;267-276.

Wagner W.L, Herbst D.R, Sohmer S.H, (1999). Manual of the flowering plants of Hawaii. Revised edition. Honolulu, Hawai'i, USA: Bishop Museum Press, 1919 pp.

Yang, A. H. and Yeh, K. W. (2005) Molecular cloning, recombinant gene expression and antifungal activity of cystatin from taro (Colocasiaesculenta), Planta Medica, 221: 493–501.

Zapata B, Fuentes V, Bonacic C, Gonzalez B, Villouta G, Bas F. (2003).