` CHEMICAL EVALUATION AND UTILIZATION OF MISTLETOES FROM SELECTED MULTIPURPOSE TREE SPECIES (MPTS) IN SEMI ARID ENVIRONMENT OF NIGERIA

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BY

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DEDICATION

This research work is dedicated to Almighty Allah for his numerous blessings to me and to all those who have contributed to make this work successful.

CERTIFICATION

This Dissertation by ADAMU Shehu (Adm. No. 16210603001) has met the requirements for the award of the Degree of Master of Science (Animal Science) of the Usmanu Danfodiyo University, Sokoto and is approved for its contribution to knowledge.

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ABSTRACT

The study evaluated the chemical composition and utilization of mistletoes as livestock feed. Random sampling procedure was applied to arrive at one hundred farmers in the study area. The study was conducted in two phases. The first phase was a field survey in which structured questionnaire was used to collect data while the second phase was a laboratory analysis in which samples were collected and analyzed for proximate components, minerals composition and anti nutritional factors. Data obtained from phase I was subjected descriptive statistics while that of phase II was analyzed using analysis of variance (ANOVA) in a completely randomized design (CRD). Results obtained shows that 89% of the respondents reported that mistletoes is moderately available, while all the respondents (100%) indicated that it is available during all seasons of the year. Significant ($P<0.05$) differences were observed between treatments in dry matter, crude protein, ether extract, ash, NFE, energy, sodium, potassium, calcium, cromium and alkaloids. No significant ($P>0.05$) difference was observed in phosphorus, magnesium, iron, cupper, zinc, manganese, saponin, tannin, phytate and oxalate. The study concluded that mistletoes parasitizing on *Faidherbia albida* was found to contained lower tannin content (131.41mg/100g) and higher (16.94%) crude protein.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Nutrition constitute a major production constraint of livestock especially during the long dry season in the semi arid zone of Nigeria. This period is characterized by inadequate feed supply and low quality and quantity of available feeds (Ogunbosoye and Babayeni, 2010). The dry season results in a rapid decline in the quality and quantity of forages leading to low forage intake and digestibility with resultant poor animal performance.

The prices of conventional feed materials used in livestock ration increased exorbitantly (Akinmutimi, 2004) and this has necessitated the search for cheap, alternative feed materials that can meet nutritional requirements of farm animals. One of such alternatives is the multipurpose tree species. Multipurpose trees species (MPTS) are trees that produce more than one output. These are in the form of fruits, nuts or leaves that can be used as a fodder, while at the same time supplying firewood, add nitrogen to the soil or supply some other combination of multiple outputs. While all trees can be said to serve several purposes such as providing habitat, shade or soil improvement, multipurpose trees have a greater impact on a farmer's well being because they fulfill more than one basic human need. The potentials of leaf, fruits and pods from tropical trees and shrubs to yield relatively high levels of crude protein and minerals and lower crude fibre levels than tropical grasses has been recognized (Mecha and Adegbola, 1980; LeHouerou, 1984; Onwuka *et al*, 1989; Dmello, 1992). Wahua and Oji (1987), Aletor and Omodara (1994), Oji and Isilebo (2000) and Okoli *et al.* (2003) have characterized the nutrient composition of some indigenous browse plants of Southern Nigeria. In general, these studies showed that crude protein and crude fibre contents of trees and shrubs range from 2.7 to 33.3%.

The nutrients composition of some browse trees (leaves, fruit, pods and pulp) in the semi arid part of Nigeria indicated that dry matter content for seeds, pods and pulp ranged from 87% for *zizziphus mauritania* seeds to 94% for *Zizziphus mauritania* pods (Okoli *et al.*, 2001). Dry matter content of the browse leaves ranged from 82.20% for *Pauparitia sirrea* to 98% for *Acacia nilotica* (Okoli *et al.,* 2001). Crude protein content for seeds, pods and pulp ranged from 5.89% to 7.4% for *Balanites aegyptiaca* seeds. Crude protein content of browse seeds, pods, and pulp is above the 7% crude protein which can support optimum microbial growth in the rumen (Oji and Iselebo, 2000); crude protein of browse leaves ranged from 13.32% for *Paupatia sirrea* to 19.36% for *Vitex doniana*. These shows that browse plants could serve as good protein supplements for ruminants.

Njidda *et al.* (2010) reported that browse leaves contained 134.8 – 449.90mg/100g calcium, 15.72-35.02mg/100g phosphorus and 16.42-136.01mg/100g of magnesium and concluded that they are adequate for ruminant. Maigandi and Abubakar (2004) also indicated that *Faidherbia albida* pods could be use at 30% to replace wheat offal in the diet of Sokoto Red goat without detrimental effects on dry matter intake and nutrients digestibility. *Zizziphus mauritania* was also used at 30% inclusion in the growing goats without compromising growth and economic performance (Njidda *et al.,* 2010). Odeyinka (2001) reported that West African Dwarf goats tolerate up to 75% Leucaena in their diet without complications arising from mimosine toxicity. Kallah (2004) also observed that the leaves of *Zizziplus mauritania* contain 16% crude protein, indicating its nutritive value as fodder with potential for use in ruminant feeding.

Despite the contributions of MPTS in the sustenance of livestock especially during the critical times of the year (dry season) its survival is being threatened by mistletoe which is a parasitic plant. Mistletoe is a parasitic plant species growing mainly on the branches of a host tree. It survived on nutrients supposed to be utilized by the plant for survival. Its impacts on the host plant is catastrophic as it causes the death of branches of the host plant thereby causing poor productivity of the plant.

1.2 Statement of the Problem

The importance of trees for firewood, timber, food and fodder is well recognized by communities in rural areas. The decreasing forest resources due to human needs other than for agricultural uses have led to shortages in fodder available for livestock. These shortages have forced livestock owners to look for viable alternatives. Leaves of browse are green all year round and many are well known to herdsmen who frequently cut down their branches for stock feeding. The fruits of some are also important feed resource during the dry season. Many browses contain high levels of essential elements such as calcium, sodium and sulphur. Mistletoes anchor themselves to their host tissues and adversely affect the growth and performance of the host. In fact mistletoe is ever green even when the host plant is dried. Therefore, it has become imperative for livestock nutritionist to investigate the role played by these parasitic plant species in feeding of livestock. This will make it possible to reduce the menace of these parasitic plants (Bamikole *et al.*, 2004).

1.3 Justification of the Study

The use of shrubs and tree fodders to supplement either natural grasses or crop residues have shown positive responses with respect to the productivity of cattle, sheep and goats. Browse in the form of trees and shrubs forms an integral part of ruminant production. Feeding browse has become an essential practice especially in the dry season when herbaceous forages are scarce (Bamikole *et al.*, 2004) and low in nutritive value (Aregheore, 2001). Abundant unconventional feed resources are available and farmers find some of them useful in livestock feeding, but restricted due to inadequate information on their feeding values. Therefore, it has become imperative for livestock nutritionist to investigate the nutritive values of these feed resources.

A wide range of alternative feed resources such as fodder, shrubs and agro industrial by products have proved efficient in improving ruminant animal productivity and reducing feed cost. Some of these alternative feed resources are fully exploited while others such as mistletoe which is a parasitic plant is yet to be fully utilized as feed resource in livestock feeding (Omolaja and Gamaye (1998). There is therefore the need to conduct a study to evaluate peoples' perception on the use of mistletoe as a fodder in livestock production as well as medicinal in humans and to evaluate the chemical composition of the mistletoe from some indigenous common MPTS in the semi arid environment of Nigeria. Livestock farmers in Nigeria especially ruminant animals farmers were using mistletoe as feed for their animals. Mistletoe is used as a whole or in combination with other feed materials, but there is little documented information on their nutritive values in the semi arid region. The present study is designed to find out farmers perception on mistletoe utilization as animal feed as well as to evaluate its chemical composition obtained from different plant species.

1.4 Objectives of the Study

The general objective of the study was to determine the various uses as well as chemical composition of mistletoes from selected MPTS in a semi arid environment of Nigeria.

1.5 Specific Objectives of the Study

1. Examined farmers perspective on the utilization of mistletoe as feed for livestock
2. Determined the chemical composition of mistletoes from selected tree species
3. Find out the anti-nutritional factors in mistletoes from selected tree species

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Feeding Problems of Livestock in Semi Arid Zone

The provision of feed that is adequate both in quality and quantity and accessible to animals all year round is the most outstanding problem of livestock production in the tropics. According to Jehsen (2012) one of the problems livestock production faced in Nigeria is feeding which usually is critical in the dry season. The natural range that form the primary source of nutrients have been observed to rapidly increase in nutritive value at the onset of rains and decline shortly thereafter. D'Mello (1992) reported that the period of low nutritive value of forages is longer during the year than when forages are in abundance with high nutritive value. Supplementation according to him with crop residues from cropped farmland scarcely meets the requirements for animal growth. The unavailability of grazing feedstuffs all year round is aggravated by the widespread bush and inbalance between the stocking rate and carrying capacity of the range. The consequences of over stocking is simply high and is aggravated by erosion and a reduction in the carrying capacity of vast land area with potential for high cattle production.

Jehsen (2012) also reported that in the event of acute shortage of range resources during the dry season, considerable losses in live weight and number of stock usually result. He further reported that the cyclical occurrence of feed deficit year in and year out impairs animal growth rate and reproductive performance while instigating movement of stock from one place to another with its numerous attendant problems including high susceptibility of animals to diseases and pest attack and often fatal clash between herders and farmers.

Umesh *et al*., (2014) reported that there are serious shortages in animals feeds of the conventional type. The grains are required almost exclusively for human consumption. The authors further reported that the increasing demand for livestock products as a result of rapid growth in the world economies and shrinking land area, future hopes of feeding the animals and safeguarding food security will depend on the better utilization of unconventional feed resources which do not compete with human food. The availability of feed resources and their rational utilization for livestock represent possibly the most compelling task facing animal scientists in the world (Umesh *et al.,* 2014).

2.2 Use of Unconventional Feed Resources

Feeds which are traditionally not used for feeding animals are called unconventional feeds (Umesh *et al.,* 2014). Tree forages forms an integral part of ruminant feeds and use of tree forages as component of diets is a wide spread practice in many countries (Meuret *et al*., 1990). Their use in livestock ration is increasing day by day due to shortage of animal feeds. The main source of such feeds is agricultural and forest by-products. Such feeds are not used either because of traditional beliefs of livestock owners or due to less palatability and presence of incriminating factors in them. D'Mello (1992) reported that certain unconventional feeds are being traditionally fed to animals in particular region, but the same may be neglected in other regions. Recent studies indicated that quite a large number of unconventional feeds could be used for livestock feeding.

According to Jehsen (2012), unconventional feeds can fit into a feeding programme as a supplement to a regular ration or as a replacement for part of the ration or pasture, especially when traditional feeds are expensive. Thus unconventional feeds could partly fill the gap in the feed supply, decrease competition for food between humans and animals, reduce feed cost and contribute to self sufficiency in nutrients from locally available feed sources. Feedstuff such as *fish offal, duckweed, patato peel, sisal waste, cactus, leucaena leaf and mistletoe* are commonly use in Nigeria and could be invaluable feed resources for small and medium size holders of livestock. The potential of unconventional feed resource lies in their nutritional composition, availability within locations, affordability interms of cost, palatability and utilization (Kaleijaiye and Balogun, 2008). In addition, nutritional constraint of most unconventional factors (tannins, saponins, cynogens and mimosine etc), low content of nitrogen (N) and poor digestion and acceptability (Leng, 1997).

2.3 Use of Foliage in Feeding Livestock

The area under fodder production is continually reducing, indicating high pressure for cash and food crop production. There is therefore need to explore new feed resources. Fodder tree leaves could supplement existing feed resources for small and large ruminants and can help to bridge the wider gap between demand and supply of nutrients (Leng, 1997). Leaves may become a rich source of supplementary protein, vitamins and minerals and their use in ruminant to enhance microbial growth and digestion (Kaleijaiye and Balogun, 2008). The leaves of different trees are fed during the period of fodder scarcity to the livestock. It is seldom realized that probably more animals can feed on shrub and tree fodder than on grasses.

Tree leaves play an important role in the nutrition of grazing animals in areas where few or no alternatives are available (Meuret *et al*., 1990). Leng (1997) reported that tannins present in tree leaves enables the ruminants to receive higher levels of dietary protein at post rumen for digestion and absorption. Fodder tree leaves are an alternative source of livestock feeding and tree leaves have potential for alleviating some of the feed shortages and nutritional deficiencies for small ruminants and are important component of goats and sheep diets (Kamalak *et al*., 2004). Fodder trees are important source of supplementary protein, vitamins and minerals in developing countries (Baumer, 1992). Supplementation of *Leucaena leucoephala* to small ruminants provided higher concentration of rumen metabolites, which naturally improved rumen function and digestibility (Bonsi, *et al.*, 1995). The feeding value of low quality roughage and grasses can be greatly improved by foliage from trees (Baumer, 1992). Tree foliage reduces the requirement for purchased concentrates and as a result decrease the cost of feeding (Singh *et al.*, 1982).

Mulberry leaves have an appreciable potential as protein source in small ruminant feeding and can be used as main feed for small ruminants and that leave of mulberry and cassava contain higher drymatter, ash and crude protein concentration than the leaves plus stems (Kandylis *et al.*, 2008). Intake was lowest and eating time longest when only leaves of mulberry were offered in feed trough (Theng *et al*., 2003). He also reported that goats prefer to tree leaves rather than grazing form a major part of their diet (Theng *et al*., 2003). Studies conducted in Nicaragua showed that supplementing cattle feed with the leaves of *Moringaoleifera* can increase milk production by 43-65%, and increase daily weight gain in cattle by up to 32% (Foidl *et al*., 2001). Leaves of cassava when fed to livestock are good source of crude protein when made into silage and livestock productivity could increase, including milk yield and body weight (Daniel, 2016) and can be used as substitute for feed grains as its leaves contained at least 20 percent protein.

The average crude protein of tree leaves range from 6.90% to 28.8% in dry matter (Verma *et al*., 1982) but younger tree leaves before flowering have more protein content than matured leaves after flowering (Nedorizesou, 1972). *Gmelina arbhorea* tree leaves contained 11.46% crude protein on dry matter basis (Majgoankar *et al*., 1987). Acacia leaves under flush growth have a crude protein content of 23% (Jones and Wilson, 1987). The mean crude protein value of leguminous browse is 15% against 13% for non leguminous browse (Jones and Wilson, 1987). *Gmelina arbhorea* tree leaves contain 2.62% and 0.37% phosphorus in the dry matter (Majgoankar *et al*., 1987).

Proximate composition of *Tamarindus indica* pulp, and *Ziziphus sipachristi* fruit were reported by (Isiaka and Violette, 2012) as 7.64% crude protein, 1.69% ash, 1.03% crude fat, 18.83% crude fibre and 56.00% carbohydrate for *T. Indus* pulp while *Z. sipachristi* fruit has 8.23% crude protein, 7.92% ash, 1.94% crude fat, 6.09% crude fibre and 58.02% carbohydrate. Minerals content of the latter (*Z. sipachristi*) were 451.9mg/100g calcium, 135.71 mg/100g magnesium, 56.93mg/100g zinc, 39.96mg/100g iron, 0.19mg/100g manganese, 1.23mg/100g cupper, 0.67mg/100g lead and 34.75mg/100g phosphorus. The minerals content of *T. indicus* pulp were 454.74mg/100g zinc, 27.36mg/100g iron, 40.20mg/100g sodium, 38.93mg/100g potassium, 0.20mg/100g manganese, 1.45mg/100g cupper, 0.66mg/100g lead and 16.34mg/100g phosphorus. Anti nutritional factors of *T. indicus* pulp and *Z. sipachristi* were 1.63mg/100g, 5.74mg/100g phytic acid, 1.55mg/100g oxalate, 0.27% tannic acid and 1.87mg/100g phytin phosphorus, 6.56mg/100g phytic acid, 8.82mg/100g oxalate and 0.47% tannic acid respectively (Isiaka and Violette, 2012).

Sclerocarya birrea fruit has high protein content (20-35%), phosphorus (0.7-1.9g/100g) and have an energy value of 25Mj/kg (Vermaak *et al*., 2011, Weinert *et al*., 1990). Aganga and Mosase (2001) reported that the fruits of *sclerocarya birrea* contained an average of 30.96% crude protein. It is also rich in oleic acid (64-74.5g/100g) with good oxidative stability, palmitic acid (11-17.5g/100g), Stearic acid (5-11g/100g) and linoleic acid 4-9g/100g (Burga *et al*., 1987). The main amino acids present in *Sclerocarya birrea* are glutanic acid 18-27g/100g protein, arginine 11-16g/100g protein and aspartic acid 5.5-8g/100g protein (Weinert *et al*., 1990).

Table 1: Proximate, Minerals and Anti Nutritional Composition of Some MPTS

Parameter	***Faidherbia albida***	***Tamarindus indica***	***Ziziphus sipachristi fruit***	***Sclerocarya birrea fruit***
Dry matter %	90.0	-	-	11.6
Crude protein %	20.6	7.64	8.23	30.9
Ash %	3.3	1.69	7.92	4.67
Crude fibre %	6.7	18.83	6.09	2.51
Carbohydrate %	46.1	56.00	58.02	-
Energy kj/100g	1682	-	-	-
Crude lipid %	13.3	1.03	1.94	-
Ca mg/100g	136.6	454.74	451.9	3.1g/100g
Mg mg/100g	135.0	16.54	135.71	2.4g/100g
P mg/100g	26.6	16.34	34.75	0.7-1.9g/100g
K mg/100g	144.5	38.93	67.98	1.2g/100g
Na mg/100g	12.5	40.20	55.01	-
Fe mg/100g	6.2	27.36	39.96	-
Cu mg/100g	5.8	1.45	1.23	-
Zn mg/100g	8.0	29.60	56.93	-
Oxalate mg/100g	-	1.55	8.82	-
Phytic acid mg/100g	-	5.74	6.56	-
Phytin phosphorus mg/100g	-	1.63	1.87	-
Tannic acid %	-	0.27	0.47	-

Source: Hassan *et al*, (2007); Isiaka and Violette (2012), Aganga and Mosase (2001)

2.4 History of the Mistletoes

Mistletoe is native to Europe and Western and Southern Asia. The North Americans and Germans use mistletoe as a ceremonial plant, while the Greeks believed that it has mystical powers (Brown, 1992). The Druids use mistletoe to welcome the New year and also for religious rites and medicinal purposes, such as treating sterility, diabetes, epilepsy and some other chronic diseases (David, 2001).

According to naturalist, Gaius pliniun Secundus and Roman author, Druids (Celtic Priests) revered Oak tree and mistletoe that grow upon it. Except green boughs of mistletoe, all sacred oaks were bare at winter celebration of Samhain, which was considered as a sign of fertility. A sprig of mistletoe was placed by celts above the door of their houses. The Austrian anthroposeophical spiritual leader (1921), reported that mistletoe is used in treating cancer. According to Milius (2000) from the centuries, mistletoe has been used as an all-purpose herbal aid.

2.5 Taxonomy of Mistletoes

Mistletoes, which consists of about 1400 species around the world, belongs to the kingdom *plantae*, sub-kingdom *Tracheobionta*, super-division *Spermatophyte*, division *Magnoliophyta*, class *Magnoliopsida*, subclass *Rosidae*, order *Santales* (Judd *et al*., 2002). Recent phylogenetic studies confirmed that mistletoes belong to five distinct families: *Misodendronaceae*, *Eremolepidaceae*, *Satalaceae*, *Viscaceae and Loranthaceae* (Der and Nickrent, 2008; Malecot and Nikrent, 2008; Vidal-Russell and Nickrent, 2008). The largest family of this mistltetoe is Loranthaceae which has 75 genera and over 900 species (Judd *et al*., 2002). Among them, six major genera are found in Nigeria, namely: *Tapinanthus*, *Agelanthus, Loranthus, Globimetula, Phragmanthera and Englerina Tapinanthus* is far more widespread in the Nigeria Savanna. (Johri and Bhatnagar, 1972; Omolaja and Gamaye, 1998). In Yoruba speaking area in Nigeria, it is called 'afomo', in Igbo 'apari' while in Hausa it is called 'kauci' and children's matches' in Eastern Cameroon, presumably due to the match-like shape of the flower (Oluwole *et al*., 2013).

2.6 Description of the Mistletoes

All mistletoes are hemiparasite, bearing evergreen leaves that photosynthesize but depend on their host mainly for water and mineral nutrients (Milius, 2000). These mistletoes grow on a wide range of host trees, and it could reduce their growth and eventually they can kill the trees by heavy infestation (Milius, 2000). Seeds of most mistletoe are spread by birds that eat the fruits (Cowles, 1964) or by the wind. The mistletoe seed germinates on the branch of a host tree or shrub and at early stages of development it is often independent of its hosts. Later, it forms a haustoruim that penetrates the host tissue and takes water and nutrients from the host plant (Milius, 2000). Many of these parasitic plants (mistletoes) can simultaneously parasitize many host species. Since different host species could supply a parasite with different resources, a mixture of host species may be superior to a single host alone. Boussim *et al*. (2004) reported that mistletoe (*T. globiferus*) parasitized 126 species, and believed that it is less specific compared to other mistletoe species. Despite the largest host range of the majority of parasitic plants, many also show high level of host preference. In mistletoe plants, the choice of host is considerably influenced by relative abundance of the hosts, as well as characteristics such as branch size, age, height and the duration of association between the host and parasite (Norton and Carpenter, 1998; Norton and DeLange, 1999; Didier *et al*., 2009).

2.7 Description of the Study Specie

Mistletoes belong to the family *Loranthacrae*. It is a woody, spreading shrub with blackish, smooth stems made rough by the presence of lenticels. The leaves are opposite and sometimes alternate. The leaf length varies from 7-15cm while the width could be 3-10cm. The leaves are thick, ovate, obtuse, rounded to cuneate at base, petiolate length up to 2cm long and grooved adaxially. Nerves pinnate with barely prominent and irregular lateral nerves. The inflorescence is a sub-sessile fascicle with up to 6 flowers. The flower is bisexual with a red corolla tube up to 2cm long and a swollen base that is greenish in colour. Calyx forming a short tube enclosing the corolla tube. The stamens are five alternating with the petals and partly fused to the petals. The unattached portion of the filament curls up as soon as the petal lobes open. The fruits are one seeded, globose and green when immature (Bassey, 2012).

2.8 Health Benefits of Mistletoes

Mistletoe is scantly use in Nigeria by few individuals as a remedy for several human and animal ailments. Similarly, only few rural subsistent farmers use the leaves to feed their livestock. The plant is however use to treat ailments such as diabetes, dysentery, wounds, diarrhoea, cancer and hypertension (Akinmoladun *et al*., 2007). Several studies have revealed that mistletoe has considerable antioxidant potential which justify its therapeutic use in herbal medicine (Obatomi *et al*., 1994; Deeni and Sadiq, 2002).

Aqueous extract of mistletoe has been reported to normalize blood sugar and cholesterol levels in rat (Ihenacho *et al*., 2008). Mistletoe, contains lectins which are protein that could bind sugars and possibly reduce the blood sugar level (Hostanska *et al*., 1995). However, most individuals do not know the nutritional and health benefits of mistletoe or perhaps, they are skeptical about its chemical composition which has not been well published. The amount of chemical compounds could vary in mistletoe leaves depending on the source of the leaves (Ishiwu *et al*., 2013). Mistletoe extract has organic compounds and chemicals which have been used for treating cancer in recent years. Studies have shown that mistletoe helps to treat nervous conditions and epilepsy. The calming effects in mistletoe help to lower blood pressure. It is equally use to make tinctures, and also drunk as tea. Medically, it is also used in injectable form. The extracts have low content of mistletoe which lowers the chances of toxicity (Obatomi *et al*., 1994).

The anti oxidant, antibacterial and anti viral activities of mistletoe herb defend the body from illness and maintain immune health. The strong immune system maintains overall health and is able to improve natural defenses of the body. Mistletoes is commonly consumed for the treatment of hypertension, ulcers, epilepsy, diabetics, weakness of vision and for promoting muscular relaxation before delivery (Basey, 2012).

2.9 Chemical Composition of Tree Forages

Many African mistletoe parasitise economic trees and presence of phytochemicals substances in African mistletoes was partly dependent on the host plant specie. They have similar morphological features however, chemical investigation established that the host influence the chemical constituents of the mistletoe. This corroborate the practice by traditional medicine practitioners in recommending their usage in various cures base on the host (Bassey, 2012).

Many African browse species contain high level of tannins which may affect intake and digestibility of roughages, protein digestibility and nitrogen metabolism in ruminants and subsequent animal performance (Abn *et al*., 1989). The utilization of browse plants is limited by high lignin content and presence of anti nutritional factors (tannin, phenolics, saponins, oxalates, phytate, hydrogen cyanide and fluro acetate) which may be toxic to ruminants (Sanon, 2007).

Many of the browse species have chemical substances that appear to be produced for the purpose of deterring invasion or consumption of their leaves by microbes, insects and herbivorous animals (Sanon, 2007). These anti nutritional factors are known to have detrimental effects which may range from reduced animal performance to neurological effects and increased mortality (D' Mello, 1992). However, values obtained from research conducted showed that the values of these anti nutritional factors are unlikely to have any deleterious effects on the animals, particularly, when use as supplement in the semi arid zone of West Africa (D'Mello, 1992).

The most widely occurring antinutritive factors in plants are group of polyphenolic compounds called tannins (D'Mello, 1992). Tannins limit animal performance by suppressing intake and digestibility of forages (Meissner and Paulsmeir, 1995). They also have beneficial effects, depending on their concentration, nature, animal consumption of the diet (Makker, 2003, Silanikove *et al*., 1996). Smaller ruminants have the ability to consume large amount of tannin rich plants without exhibiting toxic syndromes due to the detoxifying enzymes in their saliva which is not the case for other ruminant species (D'Mello, 1992).

2.10 Effects of Anti-Nutritional Factors in Forages

Anti-nutritional factors are substances which either by themselves or through their metabolic products, interfere with feed utilization or affect health and production of animal or which act to reduce nutrient intake, digestion, absorption and utilization or affect the health and production of animal or which act to reduce nutrient intake, digestion, absorption and utilization and may produce other adverse effects (Akande and Fabiyi, 2010). Many plant produce components which in their raw state contained wide varieties of anti nutrients which are potentially toxic (D'Mello, 2000). Anti nutritional compounds play a vital role in determining the use of plants for human and animals (Soetan and Oyewole, 2009). The toxicity due to the consumption of various forages is very common among the farm animals. The nutritional factors present in the forages are mainly responsible for this (Smithpatel *et al*., 2013). The major anti nutritional factor include, saponins, cyanogenic, glycosides, tannins, phytic acid, gossypol, oxalates, phytate and amylase inhibitors (Akande and Fabiyi, 2010). These factors are usually present in trace amount, but they do have profound effects on the nutritional potential of forages.

2.10.1 Phytate

Phytate which is also known as inositol hexakiphostate or phytate when in salt form, is a phosphorus containing compound that binds with minerals and inhibit mineral absorption. The cause of mineral deficiency is commonly due to its low bioavailability in the diet. High phytate contents have been found to retard growth and cause abnormalities in the intestinal histology of livestock due to damage to the pyloric region of the intestine with subsequent impaired nutrient absorption (Francis and Becker, 2002). Phytate also reduce the bioavailability of dietary phosphorus and also inhibit dietary proteins (Soetan and Oyewole, 2009). Phytate also strongly inhibit the activity of trypsin and pepsin (Panda, 2006) and reduces the the solubility of starch by binding it, reducing the absorption and hence lowering glucose utilization (Akinmutimi and Essien, 2009). Phytate chelate with divalent and trivalent metal ions such as Fe^{2+} and Zn^{2+}, thereby decreasing their absorption.

2.10.2 Tannins

This is an astringent, bitter plant polyphenolic compound that binds to and precipitates proteins and various organic compound including amino acids and alkaloids. The tannin compounds are widely distributed in many species of plants, where they have been attributed to play a role in protection from predation and perhaps also as pesticides and in plant growth regulation. Tannins have traditionally been considered antinutritional but it is now known that their beneficial or antinutritional properties depend upon their chemical structure and dosage (McGee, 2004; Katie and Richard, 2006). Tannins chelate metals such as iron and zinc and reduce there absorption and also inhibit digestive enzymes and may also precipitate proteins (Beecher, 2003). Tannins are known to be responsible for decreased feed intake, growth rate, feed efficiency and protein digestibility in experimental animals. If tannin concentration in the diet becomes too high, microbial enzyme activities including cellulose and intestinal digestion may be depressed. Tannins also form insoluble complexes with proteins and the tannins – protein complexes may be responsible for the antinutritional effects of tannin forages (Habtamu and Negussie, 2014).

2.10.3 Oxalates

Oxalate is an anti-nutrient which under normal conditions is confined to separate compartments. However, when it is digested, it comes into contact with the nutrients in the gastrointestinal tract. When released, oxalic acid binds with nutrients, rendering them inaccessible to the body. If feed with excessive amount of oxalic acid is consumed regularly, nutritional deficiencies are likely to occur, as well as severe irritation to the lining of the gut. Rahman *et al*., (2009) observed that the oxalate content in Napier grass can be manipulated by varying the harvesting interval and that oxalate content decline as the harvest interval increased.

2.10.4 Saponins

Saponins are secondary compounds that are generally known as non volatile which are widely distributed in nature, occurring primarily in the plant kingdom. The structural complexity of saponins result in a number of physical, chemical and biological properties which include sweetness and bitterness, foaming and emulsifying, pharmacological and medicinal, haemolytic properties as well as antimicrobial and insecticidal activities (Habtamu and Negussie, 2014).

Saponins reduce the uptake of certain nutrients including glucose and cholesterol at the gut through intra-lumenal physiochemical interaction. Hence, it has been reported to have hypocholesterolemic effects (Umaru *et al.*, 2007). Saponins are among several plant compounds which have beneficial which include antibacterial and antiprotozoal (Avato *et al.*, 2006).

2.10.5 Alkaloids

Alkaloids are considered to be antinutrients because of their action on the nervous system, disrupting or inappropriately augmenting electrochemical transmission. Consumption of high tropane alkaloids will cause rapid heart beat, paralysis and in fatal case, lead to death (Avato *et al.*, 2006). Uptake of high dose of tryptamine alkaloids will lead to staggering gate and death (Habtamu and Negussie, 2014).

2.11 Proximate Composition of Forages

Proximate refers to the dry matter, ash, crude protein, ether extract and nitrogen free extract of the feed (Osborne and Voogt, 1978) and proximate analysis is done to determine the approximate amount of those substances in the feed. This is done to create quality control of the various materials, ensure they do not contain hazardous chemicals and also determine whether they are healthy enough to be consumed by animals. For livestock, feed is tested to ensure that it contains enough protein, fats and carbohydrate for healthy animals. Bassey (2012) in a nutrient analysis of mistletoes on kola (*Cola acuminata*) reported moisture content of 11.70%, 69.96% carbohydrate, 9.88% crude protein, 8.9% ash and 2.90% crude fat, while in the African oil bean tree it was 12.63% moisture, 68.80% carbohydrate, 9.71% crude protein, 9.20% ash and crude fat 2.30% was reported in African oil bean tree.

Peter and Tolulope (2015) in a proximate analysis and chemical composition of Mistletoes species found on farmlands in some parts of Nigeria showed that mistletoe is highly nutritious with crude protein 19.47%, Carbohydrates, 48.60%, and crude fibre 6.80%. Franklin *et al*. (2017) conducted proximate composition and mineral analysis of *Phragmanthera capitata*, a mistletoe growing on rubber tree showed phytate 0.15 ± 0.23%, Oxalate 2.99 ± 0.61%, Saponin 3.46 ± 0.01% and alkaloid 4.20 ± 0.11%. Analysis of proximate and mineral components of Korean mistletoe (*Viscum album Var Coloratum*) from various host trees conducted by (Ghul-Woo Kin *et al*., 2018) showed that carbohydrate was the most proximate component in both leaves and twigs, followed by crude protein, crude fibre, crude ash and crude fat while the content of the proximate components and minerals varied among hosts and between plant parts, leaves were found to contained higher crude proteins except for magnesium than twigs, although no significant difference was found in mistletoe grown on *Prunusmandshurica*. However, mistletoe grown on *chaenonomelessinensis* contained higher levels of carbohydrate, crude fat, crude ash, magnesium, calcium, sodium, iron and zinc than mistletoe grown on other species. On the other hand, mistletoe grown on *Prunusmandshurica* contained high minerals level of potassium, copper and phosphorus. Nutritional value of mistletoes were greatly influenced by the host specie but even among hosts, specific nutrients accumulated in leaves more than in twigs and vice versa (Bassey, 2012).

2.11.1 Dry Matter

The dry matter of plant material consist of all its constituents excluding water. Improvement of dry matter production in the vegetative phase is a breeding objective in many crops. The nutrients in feeds required by the animal for maintenance, growth, pregnancy and lactation are part of the dry matter portion of the feed (Ogbe and Affiku, 2011).

2.11.2 Crude Protein

Proteins are an essential nutrient required for the proper nutrition of all animals. Meeting livestock nutritional requirements is extremely important in maintaining acceptable performance. Proteins are the basis of many animal body structures such as muscles, skin and hair. Proteins are also important for weight gain, growth and gestation. Young animals need diets higher in proteins than older animals (Guthrie, 1989)

2.11.3 Crude Fibre

It is a measure of fibre content in feed. Neutral detergent fibre (NDF) and Acid detergent fibre (ADF) are useful measures of feeding value use to evaluate forages. Neutral detergent fibre includes the structural components of the plant, specifically cell wall which is a predictor of voluntary intake because it provides the bulk or fill. Low neutral detergent fibre values are desired because it increases as forages matured. Acid detergent fibre is the least digestible plant components including cellulose and lignin. Acid detergent fibre values are inversely related to digestibility, hence, forages with low acid detergent fibre concentration are usually higher in energy (Osborne and Voogt, 1978).

2.11.4 Ether Extract

The ether extract of a feed represents the fats and oils in the feed. It includes the parts of a complex organic material that is soluble in ether and consists duefuly of fats and fatty acids.

Fats supplement play an important role in improving the absorption of fat soluble vitamins and reducing the powderiness of feed. Natural fats consist of 3 fatty acids and 1 glycerol component. The fatty acids profile of feeds affects the fatty acid composition of the tissues of the animal fed with these diets (Macdonald *et al*, 1995).

2.12 Minerals

Minerals are required for normal growth activities of muscles and skeletal development, cellular activity and oxygen transport, chemical reaction in the body and the intestinal absorption, fluid balance and nerve transmission, as well as the regulation of acid-base balance (Ogbe and Affiku, 2011). High amount of potassium is known to increase iron utilization (Adeyeye, 2002). Sodium is required by the body to regulate blood pressure and blood volume (Payne, 1990). Magnesium is important in tissue respiration, especially in oxidative phosphorylation leading to formation of Adenosine triphospate (ATP) (Guthrie, 1989). Iron helps in the formation of blood, and it also helps in the transfer of oxygen and carbondioxide from one tissue to another (Guthrie, 1989). Cobalt plays a role in the metabolism of vitamin B12, hence increased body ability in its absorption. Cobalt is believed to function as an activating ion on some enzymes (McDonald *et al*., 1995). Manganese is important as an activator for enzyme reactions concerned with carbohydrate, fat and protein metabolism (Payne, 1990).

Bassey (2012) reported that the mineral content in mistletoes on *Kola acuminata* was 1.10mg/100g for potassium, 0.43mg/100g for calcium, 0.12mg/100g for phosphorus and 0.09mg/100mg for magnesium, while for mistletoes on African oil bean, the mineral content was 0.12mg/100g potassium, 0.37mg/100g calcium, 0.14mg/100g phosphorus and 0.02mg/100g magnesium. Peter and Tolulope, (2015) reported the minerals composition of *Cortanarius* specie as zinc 0.08mg/100g, riboflavin 0.08mg/100g and thiamine 0.07mg/100g.

Potassium was the highest 221.67mg/100g followed by calcium 183.33mg Ishiwu *et al.* (2013) in a comparative evaluation of chemical composition of mistletoe leaves (*Viscum album*) growing on three different tree species. Avocado (*Persea Americana*), African oil bean (*Pentaclethra macro phylla*) and Kola (*Kola nitida*) which showed that mistletoe from African oil bean tree, Avocado and *Kola nitida* have antocyanin range between 0.34±0.003 and 0.37±0.181mg/100g, tanin 2.09±1.141 and 3.24±0.003mg/100g. chlorophyll A, 0.38±0.004 and 0.39±0.018mg/100g, Chlorophyll B, 0.52±0.120 and 0.50 ± 0.001 mg/100g, vitamin C 0.77±0.003 and 1.98±0.003mg/100g, folate 0.53±0.004 and 0.58±0.004mg/100g, magnesium ranged between 0.21±0.002 and 0.92±0.003mg/100g, calcium 2.14±0.004 and 2.26 ± 0.001mg/100g, sodium 0.01± 0.000mg/100g, iron 1.24 ± 0.005 and 1.42 ± 0.006mg/100g. The researchers therefore concluded that mistletoe leaves have a rich chemical composition and could thus serve as a source of these phyto-chemicals, vitamins and minerals. Peter and Tolulope (2015) in a proximate analysis and chemical composition of *Cortanarius*, however, observed the followings were relatively low, zinc was 0.08mg/100g, riboflavin 0.08mg/100g and thiamine 0.07mg/100g, potassium was highest 221.67mg/100 followed by calcium 183.33mg/100g.

2.13 Phytochemicals

Bassey (2012) conducted investigation in the phytochemicals of mistletoes (*Loranthaceae*) from two hosts species; *Penetacletha macrophylla* (African oil bean tree) and Kola (*Cola acuminata*) which are commonly consumed by people of some parts of Nigeria as herbal cure for various ailments. The phytochemical investigation showed that alkaloids, saponin, tannins, flavonoid, phlobatannin and cardiac glycosides were present in mistletoes from *P. macrophylla*, while anthraquinone were absent. However in mistletoes from *kola*, alkaloids, saponins, tannins, flavonoids, cardiaglycosides were also present, but phlobatannin and anthraquinones were absent. Antinutrient analysis of mistletoes on African oil bean showed that hydrogencyanide was 13.99mg/100g, phytic acid was 2.42mg/100g, oxalates were 38.88mg/100g, tannin content was 147.54mg/100g (Bassey, 2012), while mistletoes on *C.acuminata*, antinutrient analysis showed that hydrogen cyanide was 8.52mg/100g, phytic acid was 2.38mg/100g, oxalates was 39.46mg/100g and tannin content was 147.55mg/100g. The findings confirmed its medical value in ethnobotany and chemical evidence confirms relationship at species level. Also results of chemical test of ethanolic leaf extract of both tree species showed that alkaloids, saponin, tannin, flavonoid and cardiac glycoside were strongly present, but only trace of phlobatannins was found and anthraquinone was absent. Low values of 0.08mg/100g for zinc, 0.08mg/100g for riboflavin and 0.07mg/100g for thiamine were reported, but potassium has the highest value of 221.67mg/100g followed by calcium with 183.33mg/100g (Bassey, 2012).

The mineral composition revealed that leaves of the plant were very rich in basic minerals with high potassium level of 1047.83 ± 34mg/100g, calcium 622.58 ± 0.01mg/100g, magnesium 361.15 ± 0.01mg/100g and phosphorus 115.40 ± 0.01mg/100g. Phytochemical screening revealed the presence of varying quantities of alkaloids, saponins, tannin, oxalate, cynogenic glycosides and phytates. This shows that this specie has a great potential in completing protein and minerals deficiencies prevalent in the developing countries and the bioactive compounds make it useful for therapeutic uses. Antnutrients composition were phytate 0.15 ± 0.23%, oxalate 2.99 ± 0.61%, saponnin 3.46 ± 0.01% and alkaloid 4.20 ± 0.11% (Ishiwu *et al,* 2013).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Experimental Location

The study was conducted in four Local Government Areas (LGAs) of Sokoto State (see appendix III) namely Binji, Bodinga, Kware and Wurno. Sokoto is located between latitudes 12^0 and 13^0 05'N and between longitude 4^08 and 6^04 E in the northern part of Nigeria and at an altitude of 350m above sea level (Mamman *et al.,* 2000). The state falls within the Sudan Savannah vegetation zone, with alternating wet and dry seasons. The hot dry spell extends from March to May and sometime to June in the extreme northern part. A short, cool, dry period (Harmattan) last between late October and late February (Malami *et al.,* 2001). The mean annual rainfall is about 700m. The rainy season starts from June to early October, with a peak in August and maximum temperature of 41^0c has been reported in April and minimum of 13.2^0c in January (SEPP, 1996).

3.2 Sampling

Random sampling was used in the selection of four local government areas (LGAs) with five villages each. The areas were purposely selected based on their location. The local governments were Binji with Binji, Soron Yamma, Jamali, Kalgo and Bunkari as village areas. Bodinga Local Government with Bodinga, Danchadi, Dingyadi, Bagarawa and Tulluwa as village areas. Kware Local Government with Kware, Hama'ali, Ummaruma, Durbawa and Tsaki as village areas and Wurno Local Government with Wurno, Kwargaba, Alkammu, Achida and Marnona as village areas.

3.3 Methodology of Data Collection

The instrument used for collecting the data was a structured questionnaire (Appendix I) administered to five respondents from each village area, making a. total of 100 respondents. Demographic information collected includes number of animals, occupational status, education status, age-range, marital status, availability of the forage, feeding method (sole or combine) and constraints if any.

3.4 Selection of Host Species

Five tree specie were selected namely, *Azadiracta indica, Balanites aegyptiaca, Faidherbia albida, Ziziphus mauritania and Ziziphus sipachristi*. The species were selected base on their presence in the study area as well as infestation of the host tree species by mistletoe.

3.5 Collection of Samples

Fresh samples (leaves and twigs) of mistletoe were collected from the five selected tree species from each of the four local government areas, which constitute treatments. In each tree specie, one sample was collected which serve as replicate. The experimental design used was completely randomized design (CRD).

3.6 Samples Preparation and Preservation

Fresh leaves and twigs collected were thoroughly washed and air dried according to standard procedures and later grounded using mortar and pestle. The grounded samples were stored in polythene bags that are loosely tightened to allow for proper aeration until they were required for analysis.

3.7 Identification of Samples

Collected samples were identified as *Tapinanthus globiferus* specie at the herbarium unit of Biological Science Department, Usmanu Danfodiyo University Sokoto.

3.2.1 Analytical Technique

Representative samples of the treatments were evaluated for proximate, minerals and anti-nutritional factors content.

3.2.2 Proximate Analysis

The dry matter (DM), ash, crude protein (CP) and ether extract (EE) and nitrogen free extract and crude fibre content of the samples collected were determined as described by Association of Analytical Chemists (AOAC, 2006).

3.3 Determination of Minerals Content

Calcium (Ca), potassium (k), magnesium (Mg), phosphorus (P) and sodium (Na) were determined using Atomic Absorption Spectrometer at appropriate wavelength, while micro minerals, copper (Cu), zinc (Zn), iron (Fe), cromium (Cr) and manganese (Mn) were determined according to AOAC (2006) procedures.

3.4 Determination of Anti Nutritional Factors

Phyto-chemical analysis of the different tree species were carried out as described by Prashant *et al*. (2011) and Solomon *et al*. (2013) while phytate was determined according to the method of Lucas and Markaka (1975).

3.4.1 Detection of Alkaloids: Extracts were dissolved individually in dilute Hydrochloric acid and filtered. Filtrates were treated with Mayer's reagent (Potassium Mercuric Iodide). Formation of a yellow coloured precipitate indicates the presence of alkaloids.

3.4.2 Detection of Saponins: Extracts were diluted with distilled water to 20ml and shaken in a graduated cylinder for 15 minutes. Formation of 1 cm layer of foam indicates the presence of saponins.

3.4.3 Detection of Tannins: 1% gelatin solution containing sodium chloride was added. Formation of white precipitate indicates the presence of tannins.

3.4.4 Detection of Flavonoids: Extracts were treated with few drops of sodium hydroxide solution. Formation of intense yellow colour, which becomes colourless on addition of dilute acid, indicates the presence of flavonoids.

3.4.5 Detection of Phytate: Formation of brownish yellow coloration that persist for 5 minutes, indicates the presence of phytate.

3.5 Data Analysis

Data collected from the survey was subjected to descriptive statistics using frequency and percentile. The data generated from the proximate, mineralogical and phytochemical composition was subjected to analysis of variance (ANOVA) using completely randomized design (Steel and Torrie, 1980) with Statview Statistical Package (SAS, 2002) at 5% significance.

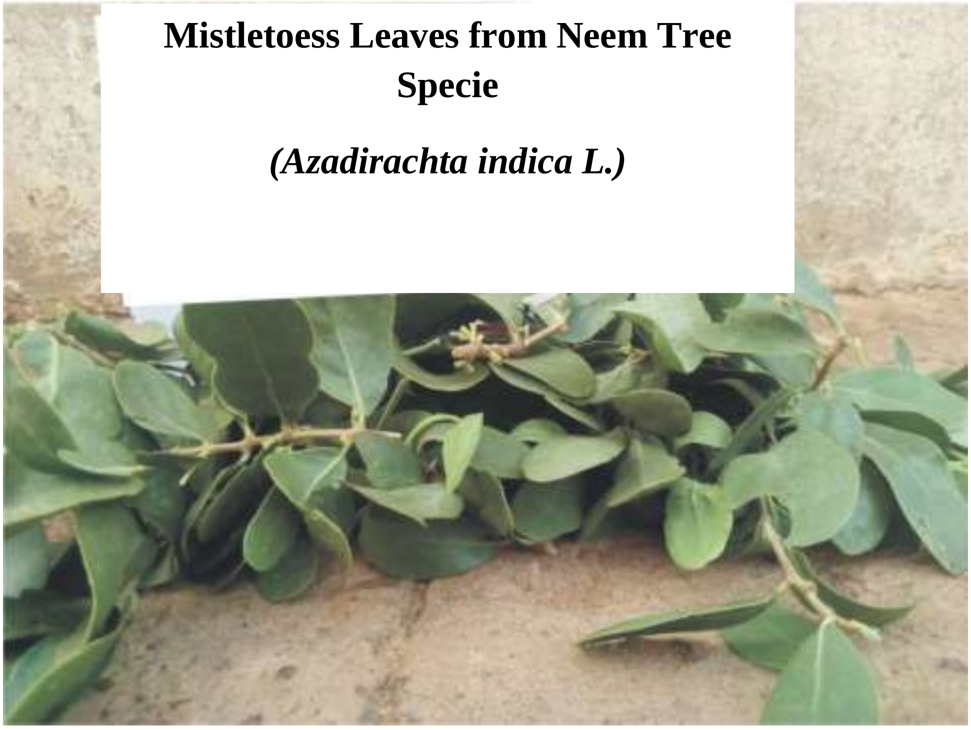

Plate 3.1: Mistletoe Leaves from *Azadirachta indica* (Neem)

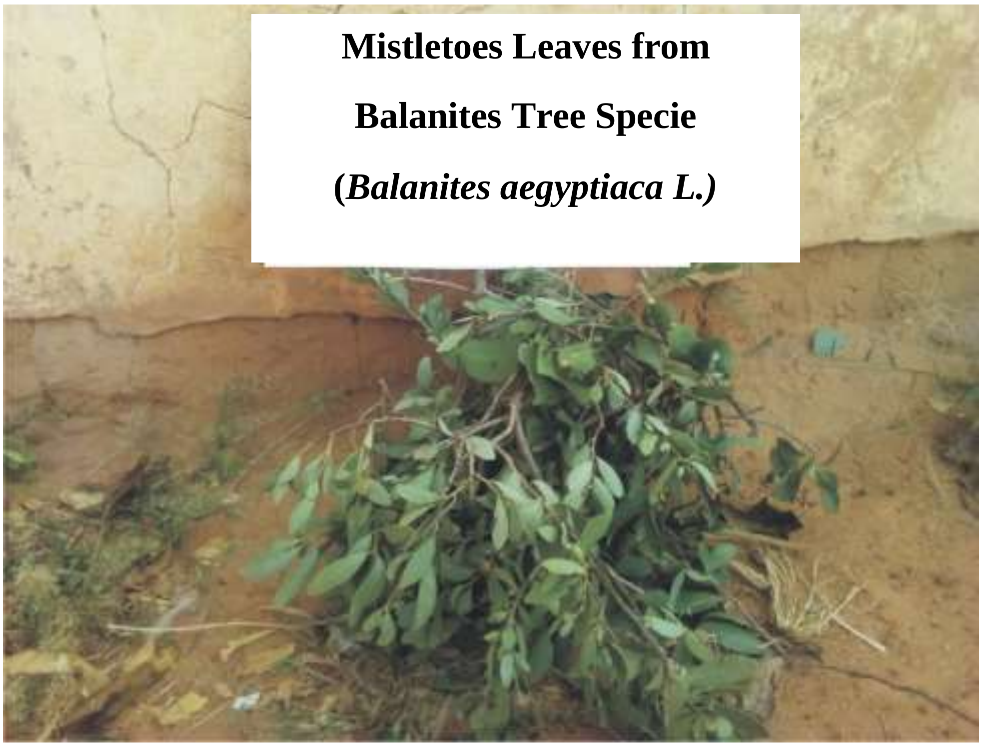

Plate 3.2: Mistletoe Leaves from *Balanites aegyptiaca L*.

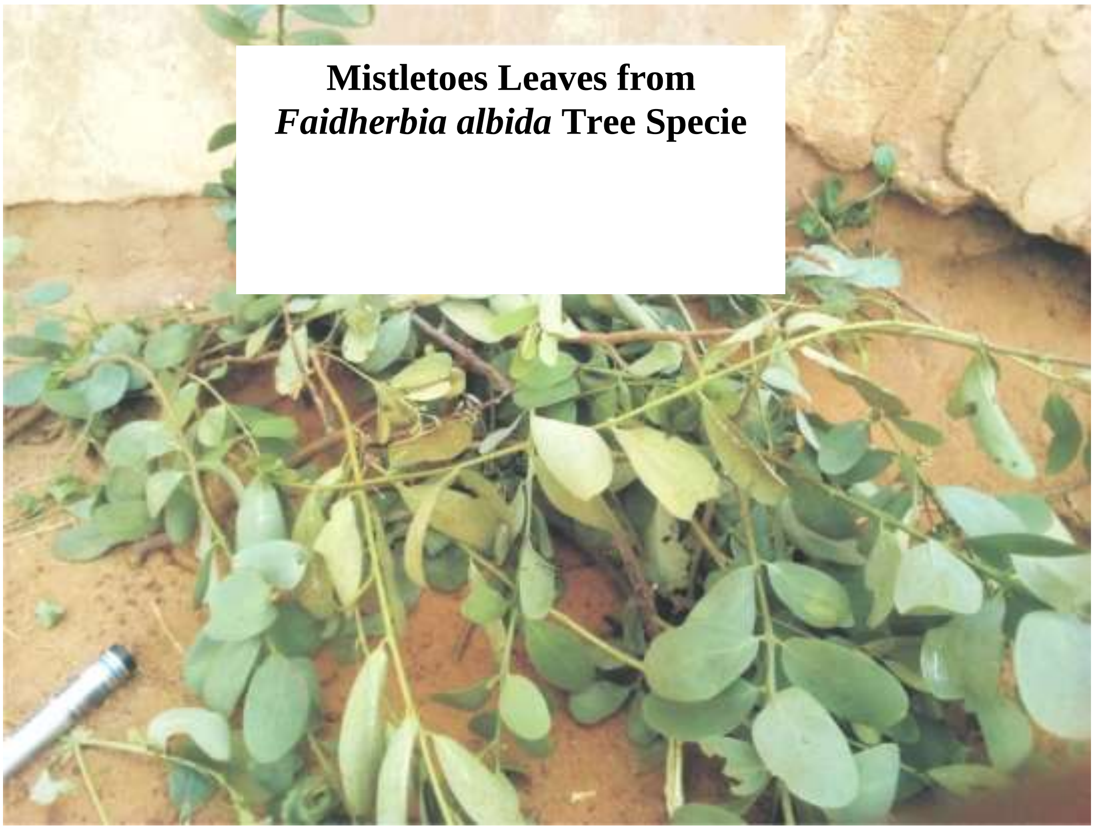

Plate 3.3: Mistletoe Leaves from *Faidherbia albida*

Plate 3.4: Mistletoe Leaves from *Ziziphus mauritania*

Plate 3.5: Mistletoe Leaves from *Ziziphus sipachristi*

CHAPTER FOUR

4.0 RESULTS

4.1 Demographic Characteristics and Sources of Foundation Stock

The results for demographic characteristics and sources of foundation in (Table 2). The result shows that 56% of the respondents were within the age range of 36-45 years. Only 16% are 26-35 years while 20% are 56 years and above. With regards to the educational attainment of the respondents result, indicated that 83% of the respondents have Qur'anic education only, 13% have primary school education, while 4% have secondary school education. Results also shows that 84% of the farmers purchased their livestock from market, while 10% inherited theirs and only 6% were gift.

Table 2: Demographic Characteristics and Sources of Foundation Stock

Parameter	Frequency	%
0 – 25 Age range (yrs)	5	5
26 – 35	16	16
36 – 45	56	56
46 – 55	11	11
56 – above	12	12
Total	**100**	**100**
Educational Qualification		
Quranic education only	83	83
Primary School Education	13	13
Secondary School Education	4	4
Tertiary Education	-	-
Adult Education	-	-
Total	**100**	**100**
Source of Stock		
Purchased	84	84
Gift	6	6
Inheritance	10	10
Total	**100**	**100**

Source: Field Survey, 2019

4.2 Feeding Value of Mistletoes

The results for feeding value of mistletoes is presented in (Table 3). Result indicated that 89% of the farmers reported that it is moderately available, while 11% reported that it is highly available. However, all the respondents indicated its availability all year round.

Findings further showed that 66% of the respondents offer the specie to small ruminants, 14% and 7% offer it to cattle and camel respectively, while 13% offer it to both small ruminants, cattle and camel. The findings further showed that 54% of the farmers reported that mistletoes is highly cherished, while 46% reported that it is moderately cherished by livestock.

Results showed that 88% of the respondents used the specie for fattening, while 12% use it for lactation. The findings showed that 94% of the farmers offered ratio of 25:75, while 6% offered 50:50 mistletoes to other feeds and all the respondents reported that livestock offered mistletoes were safe.

Table 3: Feeding Value of Mistletoes

Parameter	Frequency	%
Highly Available	11	11
Moderately Available	89	89
Not Available	-	-
Total	**100**	**100**
Season of Availability		
Dry Season	**-**	**-**
Rainy Season	-	-
All year round	100	100
Total	**100**	**100**
Animals Offered Mistletoes		
Cattle	**14**	**14**
Small Ruminants	66	66
Camel	7	7
All of the above	13	13
Total	**100**	**100**
Acceptability of Mistletoes by livestock		
Highly cherished	**54**	**54**
Moderately cherished	46	46
Poorly Accepted	-	-
Total	**100**	**100**
Purpose of Feeding Mistletoes		
Work Animals	**-**	**-**
Lactating	12	12
Fattening	88	88
Total	**100**	**100**
Proportion of Mistletoes to other feeds offered		
50:50	**6**	**6**
25:75	94	94
75:25	-	-
Total	**100**	**100**
Safety of Livestock offered mistletoes		
Safe	**100**	**100**
Not safe		
Total	**100**	**100**

Source: Field Survey, 2019

4.3 Proximate Composition of Mistletoes

Result of proximate composition is presented in (Table 4). The results shows that there was significant (P<0.05) difference in the dry matter content of mistletoes from the host species. It was significantly (P<0.05) higher for treatments 2 compared to other treatments. However, crude protein (cp) was (P<0.05) significantly high for treatment 3 and lower for treatment 1, although it contained (P<0.05) significantly higher amount of fibre (7.70%). Treatment 3 had a significantly (P<0.05) lower amount of fibre (4.32%) but higher content of energy and digestible carbohydrate (NFE). The mean value for NFE and metabolizable energy are lower in treatment 1 (47.16%) and 2541.47 k/cal/kg, respectively.

Table 4: Proximate Composition of Mistletoes

Parameter	Treatments (Host Species)					SEM
	1	**2**	**3**	**4**	**5**	
Dry Matter (%)	93.13^{e}	96.22^{a}	94.07^{c}	95.01^{b}	93.16^{d}	0.01
Organic Matter (%)	76.75^{d}	87.21^{a}	84.06^{b}	82.71^{c}	82.92^{c}	0.06
Crude Protein (%)	14.85^{d}	10.21^{e}	16.94^{a}	15.38^{b}	15.01^{c}	0.01
Ether Extract (%)	3.92^{a}	2.54^{d}	0.46^{e}	3.73^{b}	3.08^{c}	0.01
Crude Fibre (%)	7.70^{a}	3.59^{e}	4.32^{d}	6.25^{b}	5.72^{c}	0.01
Ash (%)	16.38^{a}	9.01^{e}	10.02^{d}	12.31^{b}	10.24^{c}	0.06
Nitrogen Free Extract (%)	47.16^{e}	64.65^{a}	58.27^{b}	52.34^{d}	55.96^{c}	0.07
Metabolize Energy (k/cal/kg)	2541.47^{d}	2878.84^{a}	2732.40^{c}	2729.54^{c}	2791.36^{b}	2.47

a,b,c,d = Means with different superscripts are significantly (P<0.05) different within the same row
SEM: Standard Error of Means
Key: 1 – *Azadirachta indica*, 2 – *Balanites aegyptiaca*, 3 – *Faidherbia albida*, 4 – *Ziziphus mauritania*, 5 – *Ziziphus sipachristi*

4.4 Minerals Composition of Mistletoes

The results of mineral composition of the mistletoes is shown in (Table 5). The results indicated that calcium varied significantly (P<0.05) across the treatments with higher amount in treatment 3 while the least value of 266.65ppm was for treatment 2. Phosphorus was significantly (P<0.05) higher for treatment 4 but lower in treatment 1 compared to other treatments. Significantly (P<0.05) higher amount of potassium was for treatment 4 (413.33mg/100g) while the lowest value (173.33mg/100g) was for treatment 2. Magnesium varied significantly (P<0.05) across the treatments with treatment having the least amount of 59.42pp. however, treatment 2 and 3 were similar (P>0.05). Iron content also differ significantly (P<0.05) between treatment 4 and 2 with 2.99ppm and 2.92ppm respectively but other treatments were similar both in iron and zinc. However, they varied (P<0.05) significantly in manganese.

Table 5: Minerals Composition of Mistletoes

Parameter	Treatments (Host Species)					SEM
	1	2	3	4	5	
Sodium (mg/100g)	24.18^{a}	11.02^{d}	12.59^{c}	18.07^{b}	10.42^{e}	0.01
Phosphorus (mg/100g)	0.37^{b}	0.42^{a}	0.39^{b}	0.43^{a}	0.39^{b}	0.01
Potassium (mg/100g)	396.69^{b}	173.33^{e}	260.02^{c}	413.33^{a}	176.69^{d}	0.01
Calcium (ppm)	313.33^{b}	266.65^{e}	365.56^{a}	278.82^{d}	288.95^{c}	21.30
Magnesium (ppm)	59.42^{d}	65.14^{a}	65.34^{a}	62.60^{c}	63.34^{b}	0.22
Iron (ppm)	2.72^{c}	2.92^{b}	2.73^{c}	2.72^{c}	2.99^{a}	0.01
Cupper (ppm)	0.32^{b}	0.31^{b}	0.45^{a}	0.34^{b}	0.32^{b}	0.01
Zinc (ppm)	0.05^{b}	0.04^{b}	0.06^{b}	0.07^{b}	0.11^{a}	0.01
Manganese (ppm)	0.55^{b}	0.35^{c}	0.31^{d}	0.62^{a}	0.33^{d}	0.01
Cromium (ppm)	0.01^{d}	0.37^{a}	0.02^{c}	0.01^{d}	0.04^{b}	1.92

a, b, c, d = Means with different superscripts are significantly (P<0.05) different within the same row
SEM: Standard Error of Means
Key: 1 – *Azadirachta indica*, 2 – *Balanites aegyptiaca*, 3 – *Faidherbia albida*, 4 – *Ziziphus mauritania*, 5 – *Ziziphus sipachristi*

4.5 Phytochemical Composition of Mistletoes

The result on phytochemical content of the mistletoes is presented in (Table 6) results shows that alkaloid content was ($P<0.05$) significantly higher for treatment 1 and 4 others, while other treatments were ($P>0.05$) similar. Saponin content indicated only significant ($P<0.05$) difference between treatment 3 and 5, however treatments 1, 2, 3 and were ($P>0.05$) similar. Tannin content of treatment 1 and 2 were ($P>0.05$) similar. High content of tannin 139.83mg/100g was obtained in treatment 5 which differ significantly ($P<0.05$) from the rest of the other treatments. The least content was obtained in treatment 3 (131.41mg). Phytate content in treatments 1, 2, 3 and 4 were ($P>0.05$) similar but it was significantly higher in treatment 5 (2.37mg/100g). Oxalate content of treatment 4 and 5 were ($P>0.05$) similar but significantly ($P<0.05$) different from treatments 1, 2 and 3. Oxalate content of 39.53mg/100g in treatment 4 was the highest obtained, while treatment 2 recorded the least (38.88mg/100g).

Table 6: Phytochemical Composition of Mistletoes

Parameter	**Treatments (Host Species)**					**SEM**
	1	**2**	**3**	**4**	**5**	
Alkaloid %	4.20^{a}	4.11^{b}	4.15^{b}	4.12^{b}	4.13^{b}	0.01
Saponin %	3.42^{ab}	3.41^{ab}	3.44^{a}	3.41^{ab}	3.40^{b}	0.01
Tannin mg/100g	132.20^{c}	132.10^{c}	131.41^{d}	133.14^{b}	139.83^{a}	0.06
Phytate mg/100g	2.31^{b}	2.33^{b}	2.32^{b}	2.34^{ab}	2.37^{a}	0.01
Oxalate mg/100g	38.83^{b}	38.53^{b}	38.62^{b}	39.53^{a}	39.44^{a}	0.11

a, b, c, d = Means with different superscripts are significantly ($P<0.05$) different within the same row.
SEM: Standard Error of Means
Key: 1 – *Azadirachta indica*, 2 – *Balanites aegyptiaca*, 3 – *Faidherbia albida*, 4 – *Ziziphus mauritania*,
5 – *Ziziphus sipachristi*

CHAPTER FIVE

5.0. DISCUSSION

5.1 Demographic Characteristics and Sources of Foundation Stock

Findings of the study revealed that 67% of the respondents that are engaged in farming as primary occupation were into crop and livestock production. This is similar to the findings of Charry *et al*. (1992) who reported that majority of households in Africa keep small number of ruminants alongside cropping. The study equally revealed that 56% of the respondents are within the age of 36-45 years, which run contrary to the belief that only aged rear livestock (Ajala, 2004).

Interms of educational attainment, the findings revealed that 83% of the respondents have only Qur'anic education. Majority (73%) kept livestock in form of asset and against the risk of crop failure. Maigandi and Nasiru (2006) also reported similar scenario. Small ruminants have been reported to form an integral part of the socio-cultural life and farming system of Nigerians peasant farmers (Ajala, 2004). The relatively small size of the animals reported in this study can best be explain by the management system practiced in the host communities which is predominantly Hausa, where ownership is fragmented into small number owned by members of a household (Shittu *et al.,* 2008). Moreover, within the socio economic context in which the farmers operate, flock numbers are usually low, because they can be better manage and it is within the capabilities of women and children who generally provide much of the labour required for easy expansion of their flock (Bayer and Bayer, 1991, Charry *et al.,* 1992). Majority of the respondents (84%) purchased their livestock as foundation stock and 66% of them have been in livestock production for between 10-20 years. Considering the age of the respondent farmers, it might be deduced that some of the livestock farmers started the business as early as the age of 16 years. The findings on the sources of foundation stock contradict what was found under pastoral production system (Ajala, 2004) where by inheritance is a common means of establishing foundation stock.

5.2 Feeding Value of Mistletoes

Results of the study revealed that 89% of the respondents reported that mistletoes is available in their villages, while all the respondents (100%) reported that it is available in all seasons of the year. Results also indicated that 66% of the respondents offered to small ruminants probably as a result of the relative population of the small ruminant since the farmers kept more of the small ruminant. Only 13% offered to both small and large ruminants. The whole plant is eaten by livestock and 54% of the respondents reported that it is highly cherished. This is in agreement with report of Bassey (2012) on the phytochemical investigations of mistletoes from two hosts.

Findings of this research revealed that 88% of the respondents offered mistletoes for fattening, while 12% offered during lactation. This could be attributed to the fact that farmers in most of our communities are engaged in fattening (Shittu *et al.*, 2008). Ninety four (94%) of the respondents feed it in combination with other feed ingredients in the ratio of 25:75. Such feed ingredients include wheat offal, rice bran and cowpea husk. This is in line with Charry *et al* (1992) where he reported that this trend could be attributed to the fact that majority of farmers are involved in both crops and livestock production as primary occupation. All the respondents (100%) reported that livestock offered mistletoes are safe, this is similar to the findings of Bassey (2012) who reported that it is equally consumed by people in other parts of Nigeria.

5.3 Proximate Composition of Mistletoes

Determining the chemical nutrient composition of potential feed ingredients or feeds on a dry matter basis allows for comparison between and among different ingredients and or feeds (Thiex and Richardson, 2003).

From the results it could be seen that dry matter content varied significantly across the treatments ($P<0.05$) with the higher value of 96.22% obtained from mistletoes in *Balanites aegyptiaca* host tree. The value of dry matter is comparable to the values of 95.52 – 99.35% reported by Ahmad *et al.,* (2015). Crude protein content range from 10.21% in *Balanites aegyptiaca* to 16.94% in *Faidherbia albida*. The higher crude protein from *Faidherbia albida* is in line with the findings of Onwuka, *et al*., (1989) which he reported that pods of *Faidherbia albida* are very rich source of protein and these values are above the 7% protein requirement for optimum microbial activity in the rumen (Gatemby, 2002) and therefore can adequately meet microbial needs in the rumen. The values of the crude protein in the present study except in *B. aegyptiaca* are higher than 12% reported by Gatemby (2002) for growth performance of sheep and goat. Similarly, Bassey (2012) reported crude protein values of 9.71 – 9.88% for mistletoes in other parts of Nigeria.

Ether extract, which represent the complex organic material that is soluble in ether range from 0.46% in from *Faidherbia albida* to 3.92% in *A. indica*. The highest value of 3.92% obtained is comparable to the 4.0% reported by Bakshi and Wadhwa, (2004) but lower than 21.22% obtained by Osunobun *et al*., (2015) and this could be due to variation in host, climatic and soil factors. For the nitrogen free extract it was indicated that there is significant difference across the treatments and it ranged from 47.16 for *A. indica* to 64.65% in *B. aegyptiaca*. This is comparable to what was reported by Aruwayo *et al.* (2013) which is in ranged of 48.10-50.72% but were higher than the value of 20.34% reported by Maigandi and Nasiru (2006) for *Faidherbia albida* pods. The differences could be due to the experimental materials used. The values reported in this study are equally within the range of 38.6 – 52.5% reported by Bakshi and Wadhwa (2004). Results also indicated that ash content ranged from 9.01 in *B. aegyptiaca* to 16.38% in *A. indica*. These values are higher than 14.96% reported by Osunobun *et al.,* (2015). They equally differ from 8.90 – 9.20% reported by Bassey (2012) in his study on phytochemical investigation of mistletoes from two hosts. Energy value of 2878.84k/cal/kg obtained in mistletoes from *Balanites aegyptiaca* is comparable to the energy level of 2800k/cal/kg recommended by Olumu and Offiong (1980) for starting broilers.

5.4 Minerals Composition of Mistletoes

Appropriate dietary mineral content is required for normal animal function (Ozcan, 2004). Both macro and micro-minerals contribute to structural regulatory, catalytic and physiological roles in animals (Ozcan *et al*., 2004). Sodium concentration in mistletoes obtained in this study ranged from 10.42mg/100g to 24.18mg/100g. This is higher than the value of 8.42mg/100g reported by Adubiaro *et al*., (2011) for baobab seeds but lower than 40.20mg/100 reported by Isiaka and Violette (2012) for *Tamarindus indicus* pulps. The lowest value of phosphorus (0.37mg/100g) was recorded in mistletoes from *B. aegyptiaca* and the highest from *Z. mauritania* 0.43mg/100g. This is lower than 16.34mg/100g reported by Isiaka and Violette (2012) *T. indicus* pulp but higher than 0.7g obtained by Aganga and Mosase (2001) for *S. birrea* fruit. Potassium concentration ranged from 173.33mg/100g to 4/3mg/100g in study species. The result obtained is comparable to 0.12mg – 1.10mg/100g reported by Bassey (2012).

5.5 Phytochemical Composition of Mistletoes

Utilization of plant derived by-products as sources of nutrients in livestock feeds is limited by the presence of the anti nutrient factors (Sindhu and Khetarpaul, 2002). Commonly used feeds contain anti nutrient factors, which depending on concentration in diets can be detrimental to animal health (Akande *et al*., 2010) nutrient digestion and absorption (Enujiugha, 2003) thus compromise growth performance (Tadele, 2015).

Result of alkaloids content across the treatment indicated that mistletoes from *A. indica* had the highest amount of 4.20%, while that from *B. aegyptiaca* had the least value of 4.11%.

This correlate with what was reported by Franklin et al., (2017). However, phytates was more in from *Z. sipachristi* (2.37mg/100g) but lower in *A. indica* which had 2.31mg/100g. The highest value obtained is comparable to the 2.42mg/100g reported by Bassey (2012). Tannin content in all the treatments ranged from 131.41mg/100g from *F. albida* to 139.83mg/100g in *Z. sipachristi* and this is within the range obtained by Ishiwu et al., (2013). Phytochemical range of 0.11-5.90% and 0.42-4.0% for condensed tannin and phytate were reported by Liener (1969).

From the results on proximate, mineral elements and phytochemicals, it is obvious that nutritional value of mistletoes are greatly influenced by the host species. This is in agreement with the findings of Bassey (2012) in which he reported that the host influences the chemical concentration of mistletoes, being its immediate growth environment for water and mineral salts.

CHAPTER SIX

6.0 SUMMARY, CONCLUSION AND RECOMMENDATION

6.1 SUMMARY

The study was conducted in two phases. The first phase was a field survey to obtain farmers perspective on utilization of mistletoes as livestock feed, while the second phase was laboratory analysis to evaluate proximate components, minerals and phytochemicals in mistletoes from selected MPTS.

In field survey four LGA's were randomly selected, with five villages each. Structured questionnaire was used to obtain data from five respondents from each village, making a total of 100 respondents. Convenience sampling was used to select respondents. Data obtained from the field and experiment were subjected to descriptive statistics (using frequency and percentages) and analysis of variance (ANOVA) using completely randomized design (CRD) respectively.

Results obtained indicated that 89% of the respondents reported that mistletoes is moderately available in their villages, while all the respondents (100%) indicated that it is available during all seasons of the year. Sixty six percent (66%) reported that the specie is offered to small ruminants, 88% used it for fattening and 54% reported that it is highly cherished by livestock. It has been reported by 94% of the respondents that the specie is offered to livestock in the ratio of 25:75 with other feed ingredients and all the respondents (100%) reported that it is safe in feeding livestock.

In the second phase of the research, fresh samples (leaves and twigs) of mistletoes were collected from five selected tree species (*Azadiracta indica, Balanites aegyptiaca, Faidherbia albida, Ziziphus mauritania* and *Ziziphus sipachristi*) from each of the four LGA's which constitutes treatments. From each tree specie one sample was collected which serve as replicate.

Representative samples of the treatments were evaluated for proximate, minerals and photochemical composition. Results of proximate analysis indicated that mistletoes is enriched with crude protein, ash, crude fibre, ether extract, NFE and energy. Analysis of mineral elements revealed appreciable concentration of calcium, sodium, magnesium, phosphorus, potassium, cupper, iron, zinc, cromium and manganese. Phytochemical analysis shows the presence of alkaloids, saponins, tannins, oxalates and phytates.

6.2 CONCLUSION

In conclusion mistletoes is available during all seasons of the year and farmers are using it as part of their feed component for fattening animals. It has also been found that the specie is a rich source of essential nutrients which can go along way in ameliorating most nutritional challenges that could contribute to the nutrients needs of livestock.

6.3 RECOMMENDATION

The study recommend feeding of livestock with mistletoes from *Faidherbia albida* because it was found to contained lower tannin content (131.41mg/100g) and high (16.94%) crude protein content.

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APPENDIX I

QUESTIONNAIRE ON SURVEY OF FARMERS PERCEPTION ON UTILIZATION OF MISTLETOES AS LIVESTOCK FEED IN SOKOTO STATE

Department of Animal Science,
Faculty of Agriculture,
Usmanu Danfodiyo University,
Sokoto.

Dear Respondent,

I am a student of the above mentioned university who wish to carry out a research on utilization of mistletoe as livestock feed in our communities.

Please kindly supply answers to the following questions and your answers will be treated confidentially.

Thanks

A. PERSONAL DATA

1. AGE ___________________(YEARS)
2. SEX ____________________ MALE [ ] FEMALE [ ]
3. EDUCATIONAL ATTAINMENT
   - QUR'ANIC EDUCATION ONLY [ ]
   - PRIMARY SCH. EDUC. [ ]
   - SEC. SCH. EDUC. [ ]
   - TERTIARY EDUC. [ ]
   - ADULT EDUC. [ ]
4. OCCUPATION: CEREAL/LEGUMES FARMER [ ]
   FISHER MAN [ ]
   CRAFTMAN [ ]
   TRADITIONAL HEALER [ ]
5. NUMBER OF ANIMALS OWNED _________________________________
6. WHAT IS THE SOURCE OF YOUR FOUNDATION STOCK
   PURCHASED [ ]
   GIFT [ ]
   INHERITANCE [ ]

OTHER SOURCE________________________

7. FOR HOW LONG HAVE YOU BEEN ENGAGED IN LIVESTOCK PRODUCTION

   0 – 5 YEARS [ ]
   6-10 YEARS [ ]
   11-15 YEARS [ ]
   16-20 YEARS [ ]
   20 YEARS AND ABOVE [ ]

B. STUDIED SPECIE

1. LOCAL NAME OF THE PLANT SPECIE ______________________________
2. ARE THE PLANT SPECIES AVAILABLE YES [ ] NO [ ]
3. IF YES, WHAT IS THE LEVEL OF AVAILABILITY OF THE SPECIE:

   HIGHLY AVAILABLE [ ]
   MODERATELY AVAILABLE [ ]
   NOT AVAILABLE [ ]

4. DURING WHICH SEASON IS THE SPECIE AVAILABLE

   DRY SEASON [ ]
   RAINY SEASON [ ]
   ALL YEAR ROUND [ ]

5. WHICH TYPE OF ANIMAL IS THE SPECIE OFFERED TO

   CATTLE [ ]
   SMALL RUMINANTS [ ]
   CAMEL [ ]
   ALL OF THE ABOVE [ ]

6. WHICH PART OF THE PLANT SPECIE DO YOU OFFERED TO YOUR LIVESTOCK

   WHOLE PLANT [ ]
   LEAVES ONLY [ ]

7. RANK THE LEVELS OF ACCEPTABILITY BY YOUR ANIMALS

   HIGHLY CHERISHED [ ]
   MODERATELY CHERISHED [ ]
   POORLY ACCEPTED [ ]

8. FOR WHAT PURPOSE DO YOU OFFERED THE SPECIE TO YOUR LIVESTOCK

WORK ANIMALS [ ]

LACTATING [ ]

FATTENING [ ]

ALL OF THE ABOVE [ ]

9. OTHER USES OF FEEDING THE PLANT SPECIE

MEDICINAL [ ]

FEED [ ]

OTHERS (SPECIFY) ____________________________

10. WHAT PROPORTIONS OF THE PLANT TO OTHER FEEDS USED

50:50 [ ]

25:75 [ ]

75:25 [ ]

11. WHAT ARE THE COMMON FEEDS COMBINED WITH THE SPECIE

GRAINS [ ]

WHEAT OFFAL [ ]

RICE BRAN [ ]

OTHERS (SPECIFY)____________________________

12. HOW SAFE IS YOUR LIVESTOCK OFFERED THE PLANT SPECIE

SAFE [ ]

NOT SAFE [ ]

OTHERS (SPECIFY)____________________________

APPENDIX II

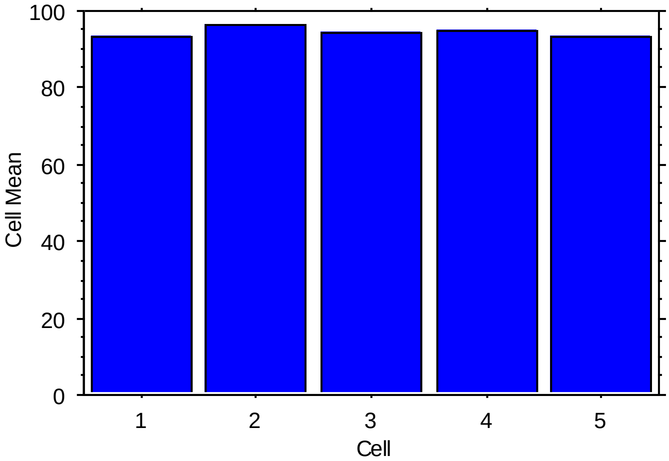
ANOVA Table for Dry Matter %

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Treatments	4	27.725	6.931	28484.764	<.0001	113939.055	1.000
Residual	15	.004	2.433E-4				

Means Table for Dry Matter %
Effect: Treatments

	Count	Mean	Std. Dev.	Std. Err.
1	4	93.127	.017	.009
2	4	96.220	.018	.009
3	4	94.070	.008	.004
4	4	95.012	.013	.006
5	4	93.155	.019	.010

Interaction Bar Plot for Dry Matter %
Effect: Treatments



Fisher's PLSD for Dry Matter %
Effect: Treatments
Significance Level: 5 %

	Mean Diff.	Crit. Diff	P-Value	
1, 2	-3.093	.024	<.0001	S
1, 3	-.942	.024	<.0001	S
1, 4	-1.885	.024	<.0001	S
1, 5	-.028	.024	.0248	S
2, 3	2.150	.024	<.0001	S
2, 4	1.208	.024	<.0001	S
2, 5	3.065	.024	<.0001	S
3, 4	-.942	.024	<.0001	S
3, 5	.915	.024	<.0001	S
4, 5	1.857	.024	<.0001	S

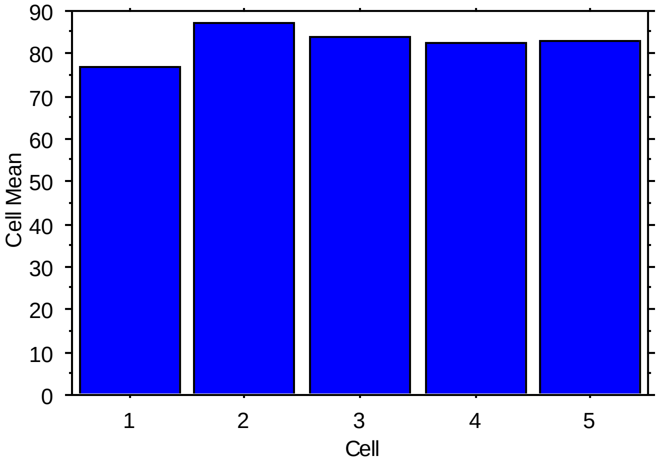
ANOVA Table for Organic Matter %

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Treatments	4	230.365	57.591	2635.559	<.0001	10542.235	1.000
Residual	15	.328	.022				

Means Table for Organic Matter %
Effect: Treatments

	Count	Mean	Std. Dev.	Std. Err.
1	4	76.752	.149	.075
2	4	87.210	.016	.008
3	4	84.055	.024	.012
4	4	82.705	.198	.099
5	4	82.915	.217	.109

Interaction Bar Plot for Organic Matter %
Effect: Treatments



Fisher's PLSD for Organic Matter %
Effect: Treatments
Significance Level: 5 %

	Mean Diff.	Crit. Diff	P-Value	
1, 2	-10.457	.223	<.0001	S
1, 3	-7.303	.223	<.0001	S
1, 4	-5.952	.223	<.0001	S
1, 5	-6.162	.223	<.0001	S
2, 3	3.155	.223	<.0001	S
2, 4	4.505	.223	<.0001	S
2, 5	4.295	.223	<.0001	S
3, 4	1.350	.223	<.0001	S
3, 5	1.140	.223	<.0001	S
4, 5	-.210	.223	.0629	

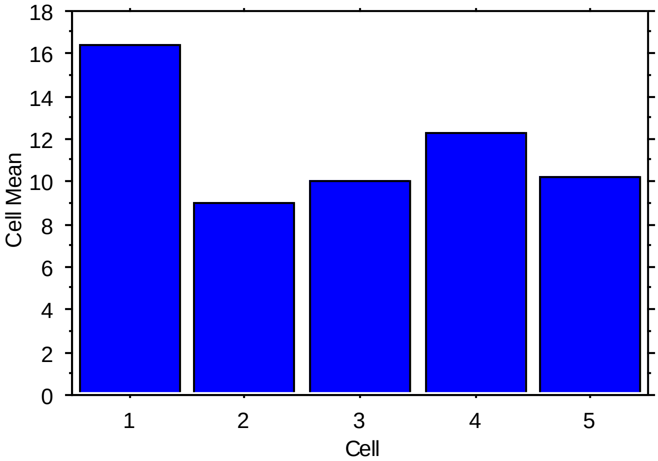
ANOVA Table for Ash %

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Treatments	4	137.482	34.371	1590.861	<.0001	6363.445	1.000
Residual	15	.324	.022				

Means Table for Ash %
Effect: Treatments

	Count	Mean	Std. Dev.	Std. Err.
1	4	16.375	.150	.075
2	4	9.010	.014	.007
3	4	10.015	.019	.010
4	4	12.307	.190	.095
5	4	10.240	.221	.111

Interaction Bar Plot for Ash %
Effect: Treatments



Fisher's PLSD for Ash %
Effect: Treatments
Significance Level: 5 %

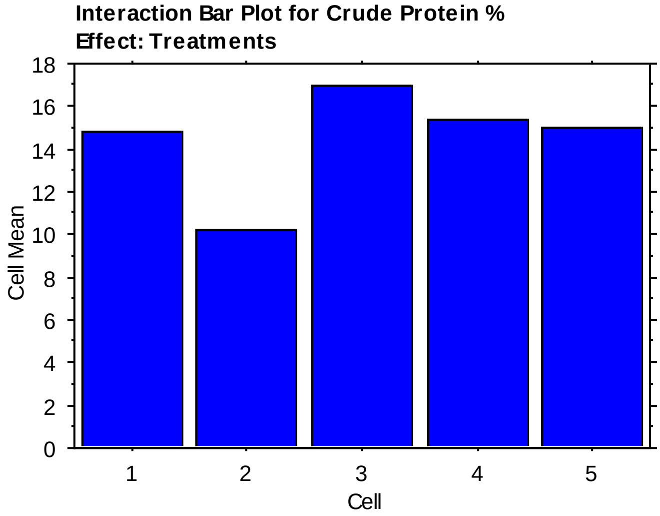
	Mean Diff.	Crit. Diff	P-Value	
1, 2	7.365	.222	<.0001	S
1, 3	6.360	.222	<.0001	S
1, 4	4.068	.222	<.0001	S
1, 5	6.135	.222	<.0001	S
2, 3	-1.005	.222	<.0001	S
2, 4	-3.297	.222	<.0001	S
2, 5	-1.230	.222	<.0001	S
3, 4	-2.292	.222	<.0001	S
3, 5	-.225	.222	.0469	S
4, 5	2.068	.222	<.0001	S

ANOVA Table for Crude Protein %

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Treatments	4	101.985	25.496	58166.418	<.0001	232665.673	1.000
Residual	15	.007	4.383E-4				

Means Table for Crude Protein %
Effect: Treatments

	Count	Mean	Std. Dev.	Std. Err.
1	4	14.845	.031	.016
2	4	10.208	.017	.009
3	4	16.935	.024	.012
4	4	15.375	.013	.006
5	4	15.010	.014	.007



Fisher's PLSD for Crude Protein %
Effect: Treatments
Significance Level: 5 %

	Mean Diff.	Crit. Diff	P-Value	
1, 2	4.638	.032	<.0001	S
1, 3	-2.090	.032	<.0001	S
1, 4	-.530	.032	<.0001	S
1, 5	-.165	.032	<.0001	S
2, 3	-6.727	.032	<.0001	S
2, 4	-5.168	.032	<.0001	S
2, 5	-4.803	.032	<.0001	S
3, 4	1.560	.032	<.0001	S
3, 5	1.925	.032	<.0001	S
4, 5	.365	.032	<.0001	S

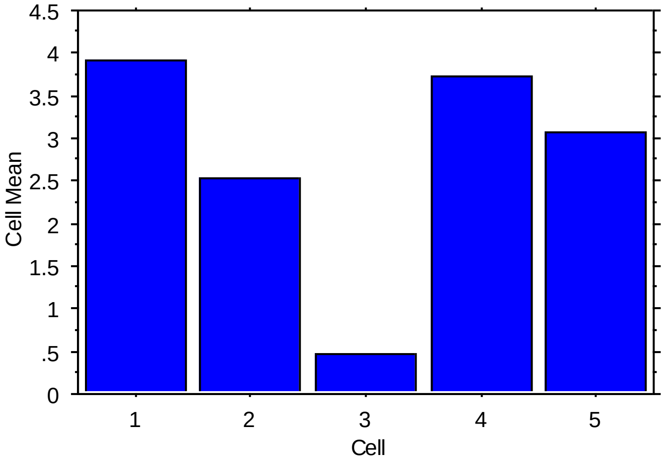
ANOVA Table for Ether Extract %

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Treatments	4	30.922	7.731	34614.325	<.0001	138457.299	1.000
Residual	15	.003	2.233E-4				

Means Table for Ether Extract %
Effect: Treatments

	Count	Mean	Std. Dev.	Std. Err.
1	4	3.922	.010	.005
2	4	2.540	.014	.007
3	4	.460	.018	.009
4	4	3.730	.014	.007
5	4	3.078	.017	.009

Interaction Bar Plot for Ether Extract %
Effect: Treatments



Fisher's PLSD for Ether Extract %
Effect: Treatments
Significance Level: 5 %

	Mean Diff.	Crit. Diff	P-Value	
1, 2	1.382	.023	<.0001	S
1, 3	3.462	.023	<.0001	S
1, 4	.192	.023	<.0001	S
1, 5	.845	.023	<.0001	S
2, 3	2.080	.023	<.0001	S
2, 4	-1.190	.023	<.0001	S
2, 5	-.538	.023	<.0001	S
3, 4	-3.270	.023	<.0001	S
3, 5	-2.618	.023	<.0001	S
4, 5	.652	.023	<.0001	S

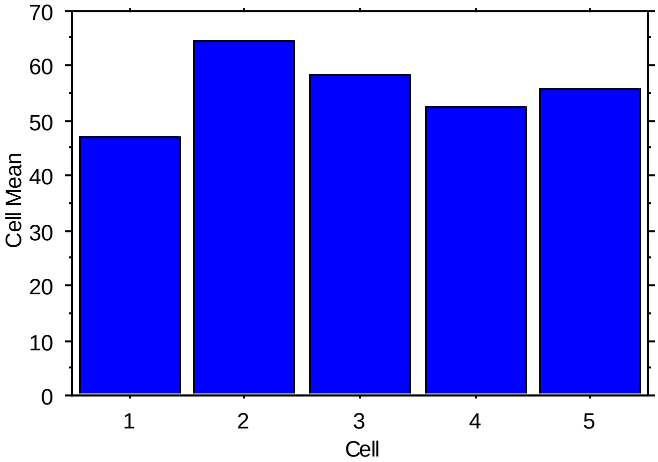
ANOVA Table for NFE %

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Treatments	4	684.193	171.048	5768.266	<.0001	23073.065	1.000
Residual	15	.445	.030				

Means Table for NFE %
Effect: Treatments

	Count	Mean	Std. Dev.	Std. Err.
1	4	47.157	.255	.128
2	4	64.653	.028	.014
3	4	58.268	.032	.016
4	4	52.343	.188	.094
5	4	55.955	.214	.107

Interaction Bar Plot for NFE %
Effect: Treatments



Fisher's PLSD for NFE %
Effect: Treatments
Significance Level: 5 %

	Mean Diff.	Crit. Diff	P-Value	
1, 2	-17.495	.260	<.0001	S
1, 3	-11.110	.260	<.0001	S
1, 4	-5.185	.260	<.0001	S
1, 5	-8.797	.260	<.0001	S
2, 3	6.385	.260	<.0001	S
2, 4	12.310	.260	<.0001	S
2, 5	8.698	.260	<.0001	S
3, 4	5.925	.260	<.0001	S
3, 5	2.313	.260	<.0001	S
4, 5	-3.612	.260	<.0001	S

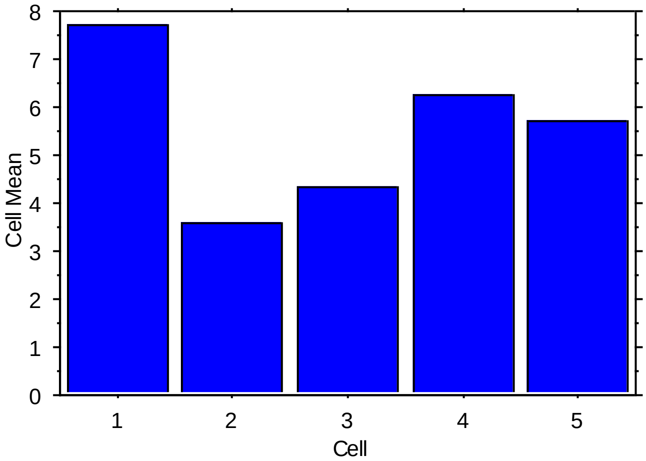
ANOVA Table for Total Fibre %

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Treatments	4	41.903	10.476	7126.403	<.0001	28505.612	1.000
Residual	15	.022	.001				

Means Table for Total Fibre %
Effect: Treatments

	Count	Mean	Std. Dev.	Std. Err.
1	4	7.700	.082	.041
2	4	3.590	.008	.004
3	4	4.322	.015	.008
4	4	6.245	.010	.005
5	4	5.718	.017	.009

Interaction Bar Plot for Total Fibre %
Effect: Treatments



Fisher's PLSD for Total Fibre %
Effect: Treatments
Significance Level: 5 %

	Mean Diff.	Crit. Diff	P-Value	
1, 2	4.110	.058	<.0001	S
1, 3	3.377	.058	<.0001	S
1, 4	1.455	.058	<.0001	S
1, 5	1.982	.058	<.0001	S
2, 3	-.732	.058	<.0001	S
2, 4	-2.655	.058	<.0001	S
2, 5	-2.128	.058	<.0001	S
3, 4	-1.923	.058	<.0001	S
3, 5	-1.395	.058	<.0001	S
4, 5	.527	.058	<.0001	S

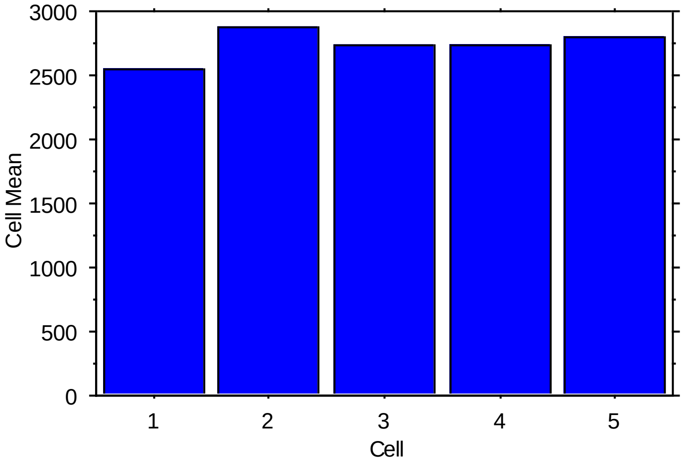
ANOVA Table for Metabolizable Energy MEKcal/kg

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Treatments	4	245420.151	61355.038	1733.350	<.0001	6933.399	1.000
Residual	15	530.952	35.397				

Means Table for Metabolizable Energy MEKcal/kg
Effect: Treatments

	Count	Mean	Std. Dev.	Std. Err.
1	4	2541.470	7.616	3.808
2	4	2878.835	.766	.383
3	4	2732.398	.973	.486
4	4	2729.537	7.334	3.667
5	4	2791.360	7.978	3.989

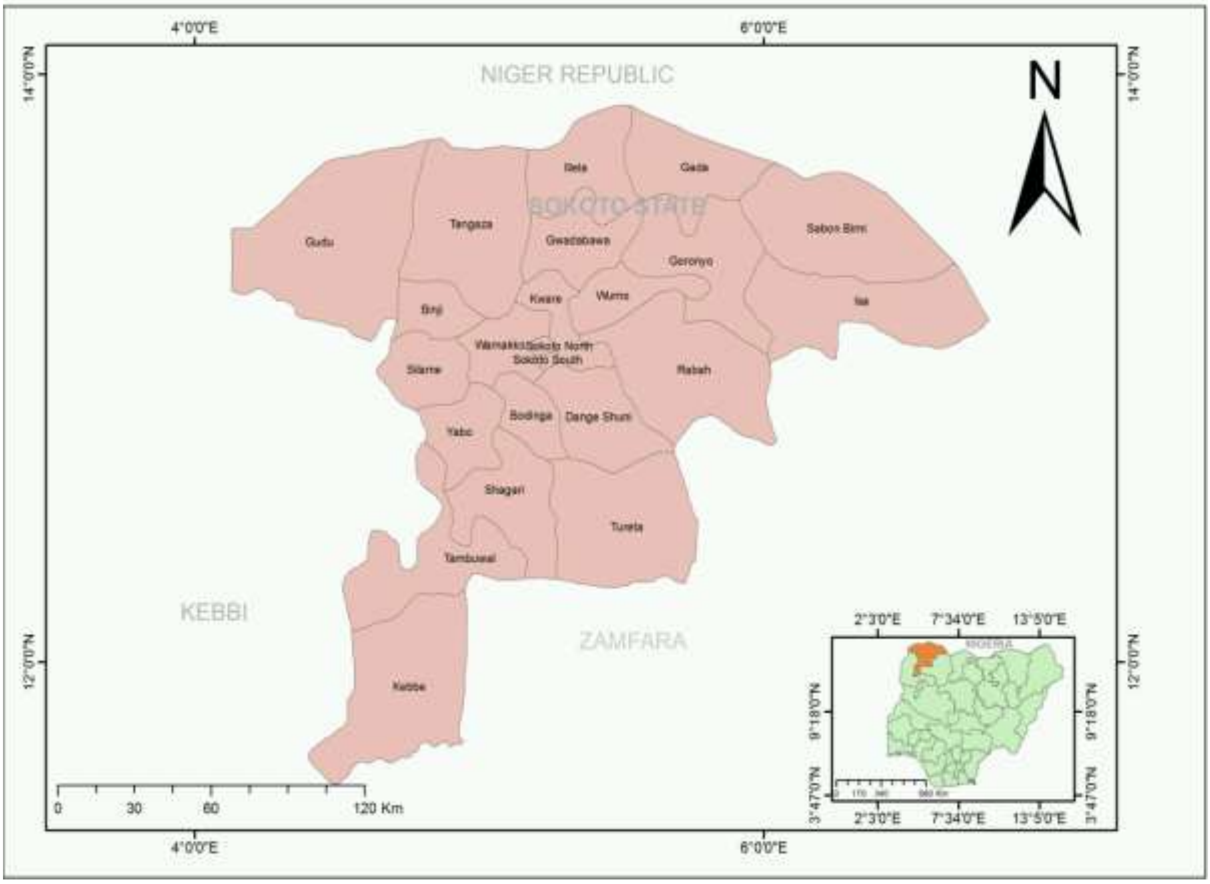
Interaction Bar Plot for Metabolizable Energy MEKcal/kg
Effect: Treatments



Fisher's PLSD for Metabolizable Energy MEKcal/kg
Effect: Treatments
Significance Level: 5 %

	Mean Diff.	Crit. Diff	P-Value	
1, 2	-337.365	8.967	<.0001	S
1, 3	-190.928	8.967	<.0001	S
1, 4	-188.068	8.967	<.0001	S
1, 5	-249.890	8.967	<.0001	S
2, 3	146.438	8.967	<.0001	S
2, 4	149.298	8.967	<.0001	S
2, 5	87.475	8.967	<.0001	S
3, 4	2.860	8.967	.5070	
3, 5	-58.962	8.967	<.0001	S
4, 5	-61.822	8.967	<.0001	S

APPENDIX III



Map of LGA's in Sokoto State