Effect of Feeding Varying Proportions of *Ficus Thonnningii* Leaves on Feed Intake, Weight Changes and Reproductive Performnce of *Yankasa* Ewes

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DECLARATION

I hereby declare that the work in this project is carried out by me at the Sheep Project unit Small Ruminant Research program, National Animal Research Institute, Ahmadu Bello University, Zaria.

No part of this thesis has been presented in any previous publication for a higher degree. All sources of information are acknowledged by means of references.

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CERTIFICATION

This thesis by Fatima Bibi-Farouk meets the regulations governing the award of Master of science (Animal Science) of Ahmadu Bello Univeresity and is approved for its contributions to scientific knowledge and literary presentation.

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This work is dedicated to my father Alhaji Ibrahim for the foundation, my mother Hajia Aishatu Yalli for the encouragement and to my daughter Amal.

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TABLE OF CONTENT

CHAPTER 4

LISTS OF TABLES

LISTS OF PLATES

LISTS OF FIGURES

Abstract

This study was carried out to identify *Ficus* species found inside the premises of the National Animal Production Research Institute (NAPRI), Shika, Zaria and to determine the effect of including varying proportions of *Ficus thoninnigii* in hay diet of Yankasa sheep on their productivity. Eight *Ficus Species* were identified, namely, *F. capensis, F. gnaphallocarpa, F. ingens, F. illeophylla F. platyphylla, F. polita and F. thonningii. Ficus thonningii* was the most abundant specie in NAPRI and it was therefore used in this study.

Proximate analysis of the leaves of all the species found at NAPRI was carried out. Their chemical composition showed that the mean % crude protein (CP), acid detergent fibre (ADF) and lignin content were 9.6±0.63, 33.1± 0.68 and 5.3±0.9% respectively. Mean % dry matter (DM) was 34±3.15 and ranged from 28.0 t0 48.5%. Mean ether extract (EE) was 3.53±0.68 with a range of 2.14 to 6.65%. The C: P ratio was 9:1

The effect of feeding basal diets consisting of 0, 25, 50 and 75% of fresh *F. thonnigii* leaves on intake, weight changes, and reproductive performance was studied using thirty-eight 2-3year old Yankasa ewes. The basal diet was fed at 3% live weight while a 15% CP concentrate supplement was uniformly fed across treatment at 1% live weight, over 60day period.

Forage intake differed significantly ($p<0.05$) between treatments. Increased intake was observed with increase in quantity of browse offered. Animals in group D (75%) had the highest forage intake (2.59% live weight) while the control group (A) had the least (2.24% live weight). Animals on the 25 and 50% treatment groups (B and C) had similar intake (2.38 and 2.39% live weight) respectively. However, a limit in browse in take was observed in which only 61.5% of *Ficus* leaves was consumed out of the 75% offered.

Average daily gain (ADG) differed significantly ($p<0.05$) between groups. The highest gain was obtained in group B ($68.0\pm0.68gd^{-1}$). However, weight gain was not affected with increase in total DM intake as animals with the highest intake gained the least weight ($46.0\pm0.68gd^{-1}$).

Oestrous cycle lengths (OCL), frequency of oestrus (FO), lambing and conception rates (LR and CR) were normal across groups. Mean OCL averaged17.2 ±0.2days while 85.5% of the expected oestrus periods were observed in all ewes. Overall, CR, LR and litter size (LS) were 89.5%, 82.4% and 1.1 respectively.

Replacing *D smutsii* (pangola grass) with up 75% of fresh leaves of *Ficus thonnigii* in a basal diet did not affect progesterone profile or normal cyclic pattern of oestrus. No apparent toxic effect was observed throughout the experimental period, but animals fed diet consisting upto 75% browse had the least weight gain, conception rate and litter size.

From this study, it can be concluded that inclusion of fresh leaves of *F. thonningii* in a basal diet of *D smutsii* for Yankas ewes should not exceed 50% for practical and beneficial purposes and the use of this readily available feed resource especially in the dry season is recommended.

1. INTRODUCTION

Ruminant animals possess the ability to thrive mainly on forage, crop residues and other agro-industrial wastes without competing with humans and industries for grains. However, one major constraint faced by these animals in the semi-arid and sub humid regions of Nigeria is the acute shortage of feed especially fodder, in the long, dry season. Even if grass is available it is usually dry, fibrous and unpalatable to the animals and often with very low nutritive value. Livestock then supplement this poor grass with leaves of trees and shrubs that are available and edible.

The foliage of browse trees and shrubs in the semi-arid and sub-humid zone is either deciduous or persistent according to species. For persistent plants, the young leaves usually emerge during the dry season between December and February or at the end of this season. This provides a fresh green stage of new shoot, buds and/or flowers and fruits to livestock (Toutain, 1980). The production figure of browses in the Sahelian and Sudanian zones of Africa is reported by Le Houérou (1975) to range from 200 to 1500 kg DM of consumable feedstuff per hectare per year according to vegetation type. Le Houérou in (1980a) again reported that 20-30% of dry season feed of Sahelian and Sudanian zones of Africa is supplemented by browse species. Nutritive values of browse plants are higher in crude protein (CP) ranging from 9.4 to 16.9% DM (Mecha and Adegbola 1980); they are also rich in vitamins and minerals and lower in crude fibre than grasses.

Among the most selected and most palatable browse species to sheep and goats in Nigeria are trees belonging to the genus *Ficus* (Mecha and Adegbola, 1980). These are either trees or shrubs, often epiphytes with aerial roots hanging down. They are usually recognized by their milky latex, fruits and scars left when the leaves fall off. Thirty- nine species are found distributed in different parts of Nigeria (Hutchinson and Dalziel, 1958) (Appendix I).

Most of the investigations carried out regarding the nutritive value of different species of *Ficus* were in Asia. Jacob (1941) showed *F. sycomorus* to have higher nutritive value than dry season grazing, while Metha and Bhaid (1986) showed that goats fed with *F, tsiels* gained 41.7 g daily. Varma et al. (1982) found the species *F. nervosa* to contain 25.9% CP.

Like most browse species, some *Ficus* species are speculated, to have detrimental effects on livestock. *Ficus semicordata, F, clavata* and *F. hispida* were reported to cause abortion and decrease milk yield (Joshi and Singh, 1990). Also, herdsmen around Shika, cautioned against feeding some species of this genus to pregnant livestock because they believe that they cause abortion.

Information regarding nutritive composition, toxic properties and effects of any of the Nigeria *Ficus* species is scarce even through many members of the genus are used locally both as livestock feed and medicine. The study presented in this thesis therefore, had the following objectives:

1. To identify all *Ficus* species found within the premise of NAPRI, Shika, Zaria, Nigeria.
2. To determine the proximate composition of their leaves.
3. To select the one specie that is abundant and determine its use as dry season feed for Yankasa ewes
4. To determine its effects on the performance of the ewes in a 60-day feeding trial with particular reference to the following parameters:

- Fed intake
- Weight gain
- Oestrous cycle length
- Frequency of oestrus
- Conception rate
- Lambing Rate

5. To evaluate the effects on peripheral plasma progesterone levels of ewes fed varying proportions of *F. thonningii* during their oestrus cycles.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 General Description and Distribution of *Ficus* Species

The genus *Ficus* belong to the family *Moraceae*. The plants are either trees or shrubs with few being woody herbs. Some species of *Ficus* show remarkable development of aerial roots and many start life as epiphytes on other trees. The aerial roots embrace the stem of the host and in time replace it by their growth, uniting and forming the compound trunk which eventually kills the host plants and becoming and independent tree. Members of this genus are usually recognized by their milky juice, fruits and scars left by the leaves when they fall off (Dalziel, 1937).

Branches could be glabrous or pubescent and the leaves are simply usually alternate rarely opposite, often cadaceous and leaving scars when they fell off. Flowers are unisexual, having numerous inflorescence in a closed, thick fleshy, bag-like receptacle which is called the fig. The fig is hollow and close at the top, except for a small ostiole (opening) which usually has bracts surrounding it. The fig may be hairy or hairless, globose or ovate in shape (Hutchinson and Daiziel, 1958). Report by McClean and Ivimey-cook (1956) showed that the wild fig produces 3 distinct types of fruits each year, namely: "*Profichi*" which is produced in February, "*Mammoni*", formed at the end of May and "*Mamme*" which develop at the end of summer.

The genus has about 800 species distributed all over the tropics. The most popular of this genus is *F. carica* which originates from Carica in Asia Minor but now adopted and widely cultivated in many parts of the temperate and Mediterranean world (Condit, 1947). Hutchinson and Dalzell (1958) reported 59 species found in tropical West Africa with 39 species found Nigeria. Watt and Breyer-Brandwijk (1962) found 25 species in Eastern and Southern Africa. The Biological Science Department Herbarium of Ahmadu Bello University has identified 17 species, 15 found in Zaria district, one from Bauchi and the other from Kafanchan.

2.2 Role of Browse in Animal Production

Browse plant serve as food source for ruminants during period of feed scarcity. The period of scarcity in Nigeria is the dry season. At this time new leaf flush of most browse trees and shrubs starts long before the rains begin while grass growth begins only with the rains. At the time when grass biomass and quality are minimal, the woody vegetation produces high quality and palatable food source. One major value of browse trees and shrubs in animal production is that they provide food rich in vitamins, protein and mineral elements which are lacking during the long dry or cold seasons. They also enable standing feed reserve to be built up so that livestock are able to survive critical periods of prolonged drought without losses.

Le Houérou (1980a) stated that browse in the Sahelian and Sudanian zones represent 20-30% of livestock diet during the long dry season which may last 5-11 *months without supplementation. Reports* by Audru *(1980) and Toutain* (1980) show that animal production in the Guinea zone has never depended on existence of savannah as is generally believed, but on browse. This is because land reclamation and control requires heavy investment. In karoo and valley Bushveld of southern Africa, livestock production is based entirely on browse because soil erosion does not allow grass growth (Lawton,1980). According to Floret and Le Floc'h (1980), browses provide the means of pastoral production on a regular basis than do annuals during unfavourable rainfall years in Tunisia. Also in North America, report from Cook and Harris (1960), shows that the shrubs of the Great Basins desert rangeland provide 50-70% of the diet of sheep and 40% of cattle that graze these lands during winter.

For any browse to be able to play significant role in animal production, it should be available in large quantity. The main parts of the plant eaten by animals are the leaves and young twigs. It is difficult to measure the amount of leave provided by a browse species as it is influenced by many factors (age of plant, defoliation and rainfall). However, when considering the purpose of browse plants as a source of fodder for the dry season or drought years, it is no longer necessary to engage in measures of true productivity (Wilson and Harrington, 1980). The standing crop foliage on trees and shrubs is most readily estimated by regression equations relating leaf weight to stem diameter or shrub's height. This has been done successfully by Burrows and Beale (1970) for *Acacis* *aneura*. Another way of assessing browse production is to measure leaf fall, for mature stands. Foliation can be assumed to be constant with growth equivalent to leaf shedding (Wilson and Harrington, 1980).

Production figures for semi-arid and humid zones of tropical Africa range from 200 to 1500 kg DM consumable feedstuff per hectare per year, according to vegetation type and rangeland condition (Le Houèrou, 1975). Mean estimate of consumable browse (dry matter per millimetre rainfall per hectare per year) in Sahelian and Sudanian zones of tropical Africa is given by Le Houèrou (1980b) as:

150 kg DM/mm/ha/year in the Saharo-Sahelian zone;

300 kg DM/mm/ha/year in the Sahelian zone;

500 kg DM/mm/ha/year in the Sahelo-Sudanian zone;

700 kg DM/mm/ha/year in the Northern Sudanian zone;

1000 kg DM/mm/ha/year in the Southern Sudanina zone;

In evaluating forage species as animal feed, it is important to obtain information regarding their nutrient status, digestibility of these components and forage intake. These values usually determine the amount of energy and protein that can be obtained by the animal and will help in predicting the animal's productivity. Comparing browse with dry mature tropical grasses, browse has been shown to be richer in protein and mineral elements (Rose-Innes, 1964; Audru, 1980; Mecha and Adegbola, 1980; Le Houèroe, 1980a). In addition, the proportion of silica is 2 to 3 times lower in browse. Dry grass has very low and often zero digestible crude protein (DCP = 0.80% or less) and practically no carotene (Wilson and Harrington, 1980) and very low phosphorus (Le Houèrou, 1980a). In terms of energy, browse contains double the amount in dry grass owing to the low content in crude fibre. Work by Mecha and Aedgbola (1980) showed that the Southern Nigerian browse species contained about 31.4 to 34.2% DM with CP ranging from 9.4% to 16.9% of DM.

Given the above, dry mature grass that is usually available in the dry season cannot ensure livestock maintenance without additional supplementation in the dry season. This supplementation usually comes from the browses.

2.3 *Ficus* Species Browsed by Livestock and their Nutritive Value

Representatives of the genus *Ficus* are intensively used as dry season fodder in the tropics. Various workers have established the nutritive value of some and reported on their uses as livestock feed (Jacob, 1941; Hussain-Mia et al. 1960; Rose-Innes, 1964; Le Houérou, 1980a).

Wickens (1980) listed the following species - *F. glumosa, F. gnphalocarpa, F. ingens. F. ovata, F. platyphylla* and *F. vogelana* to be browsed in the Guinea zone of Africa and Audru (1980) reported *F. thonningii* to be among the most palatable species in the same zone. In the Sahelian and Sudanian zones, *F. asprifolia, F. capensis* and *Ficus thonningii* are browsed by livestock (Le

Houèrou, 1980b). The nomads are reported (Toutain, 1980) to lop down *F. gnaphalocarpa* for their herds while the village people eat the fruits in the Sudnian zone of West Africa. The proximate composition of this specie was reported by Rose-Innes (1964) as 33.9% DM, 8.9% CP, 14.9% CF, 4.8% DP, 16.0% Ash, 0.4% P and 2.6% Ca.

In Southern Nigeria, Mecha and Adegbola (1980) reported *F. elasticoid* to be among the most selected browse by sheep and goats and they found its proximate composition to be 52.55% DM, 14.89% CP, 29.80% CF, 44.20% NFE, 4.70% EE, and 3.00% Si. Palatability studies by Carew et al. (1980) showed *F. exasperata* to be among the most palatable browse species, and reported its proximate composition to be 54.0% DM, 10.00% EE, 12.00% Ash, 25.00% CF and 38.55% NFE.

In the arid and desert regions of North Africa, *F. carica-rupestris, F. ingens, F. pseudosycomorus, F. salicifolia* and *F. teleukat* are browsed by camels, sheep and goats (Le Houèrou and Corra, 1980). However, *F. sycomorus* and *F. salicifolia* were found to be unpalatable to livestock. But, Lamprey et al. (1980) reported that leaves, twigs and bark of *F. sycomorus* are eaten by elephants in Kenya; and Jacob (1941) found its proximate composition to be 13.44% CP, 2.61% EE, 15.44% Ash, 14.20% CF and 54.70% NFE. He further showed the feeding value of leaves is much higher than dry season grazing and the leaves could be valuable feeding stuff in overstocked or in semi-arid areas.

Chopra et al. (1965) reported that leaves, twigs, bark and branches of many species of *Ficus* were valuable fodder to elephants and cattle in India. Devendra (1981) also stated that the following species, *F. bengalensis*, *F. religiosa* and *F. glomerata* were quality feed to sheep and goats in South East Asia. Proximate analysis of these 3 species has been carried out by Hussain-Mia et al. (1960) and revealed that these 3 species consist of 9.63, 13.99, and 11.16% CP, 2.64, 2.71, and 12.27% CF respectively. Varma et al. (1982) analysed 5 species of ficus that were fed to livestock during the dry season in the Hill Region of North Eastern India and the result was as shown in the table below (Table 1).

Table 1 Proximate Composition of Ficus Spp. Fed to Livestock in Hill Region of N.E. India (%DM).

Species	CP	EE	CF	Total Ash	NFE	DM
F. cunia	15.19	1.08	23.85	9.63	50.20	90.32
F. hispida	20.83	3.72	12.48	21.08	41.89	78.92
F. neriifolia	17.95	1.23	16.47	3.71	60.64	96.29
F. religiosa	20.49	5.38	22.56	13.75	27.82	82.43
F. nervosa	25.92	2.00	26.70	17.57	27.82	82.43

Studies by Metha and Bhaid (1986) on the digestibility and nutritive value of fresh leaves of *F. tsiela* showed that six-year old male goats gained a mean of 41. 7 g live weight daily while feed intake ranged from 3.69% to 4.55% of live body weight. Chandra and Bhaid, (1987) in a similar study with dried leaves of the same species found that total DM intake was 2.52±0.09kg while proximate composition of the leaves was 7.3% CP, 72.3% DM, 61.4% NDF and 36.7% ADF. In Majorca and Greece the leaves of *F. carica* and dried unripe fruits are used for hog fattening (Condit, 1947).

2.4 Phytochemical Studies, Pharmacological Studies and Uses of *Ficus* Species

Phytochemical analysis of plants involves the extraction of the plant materials, separation and isolation of the constituent (s) of interest, characterization of the isolated compounds and quantitative evaluation. This investigation is then correlated with pharmacological and physiological activities so that the use of the plant could be explained (Trease and Evans, 1978).

Investigations, by different workers (Altman1958; Brahmachari and Augushi, 1964; Watt and Breyer - Brandwijk, 1962) on different species of *Ficus* have shown that many of the plants contain sterols, alkaloids, flavonols and flavonoids, glycosides, triterpene steroids and proteolysis compounds. Some of these plants are utilized as medicine while others have toxic properties. Below is a list of some plants in the genus *Ficus,* their chemical composition, pharmacological action and uses.

2.4.1 *F. anthelmintica*

The leaves and latex of this plant are used by the Amazonian people as vermicide (Altman, 1958). It was found to contain saponin as a major constituent, while other compounds like glycosides, phospholipids, sterols and alkaloids were also found. The presence of pseudopelatienine, another vermicide, was also suspected in the plant. Santonin was found to be responsible for the anthelmintic action (Altman, 1958).

2.4.2 *F. bengalensis*

Brahmachari and Augushi (1964) isolated 3 flavonoid compounds from the bark. Two were identified as lecoanthocyanidin, while the other was identified as lecoanthocyanin. All 3 were effective as hypoglycemic agents on oral administration to fasting rats. Lecoanthocyanin showed maximum effect when compared with tolbutamide and was also effective in controlling the hyperglycemia produced by oral administration of glucose to fasting rabbits. Gupta (1966) also reported the same effect on rats. Compounds isolated from the dried leaves of this species were identified by Chatterjee and Chakraborty (1975) to be a triterpene friendelin and β-sitosterol. August (1975) isolated a glycoside from the plant and found it to be hypoglycemic in normal and alloxan rabbits.

2.4.3 *F. capensis*

Ilyas and Ilyas (1990) isolated and identified a flavonol glycoside and 2 free aglycones from the leaves. One of the aglycone was characterized as ningerin (I) while the other was characterized as 3-methoxy-4,-5,7-erihydroxy flavonol (isorhamnetin II). The glycoside was characterized as isorhamnetin-3-glucoside. The fruits are sometimes eaten or chewed like kola nuts both for thirst and as remedy or sore throat in Northern Nigeria; while the Fulani give both fruits and leaves to bring about increase in their herds and to increase the milk yield of the cow (Dalziel, 1937). Watt and Breyer-Brandwijk (1962) reported that the Zulu drink a decoction of the root and the bark as remedy for suspected ulceration of the lungs. They give an infusion of the roots and leaf and administer a decoction of the root to cow with retained placenta to assist its expulsion. In Tanzania a decoction of the bark is used as a wash for the udder to stimulate milk secretion and the bark is used as a galactagogue both in women and cow. The leaves, root and bark were found to tes' positively for sterol (Watt and Breyer-Brandwijk, 1962).

2.4.4 *F. carica*

A furocoumarin ficusin also known as psoratene with melting point of 161.5-162.5^{0}c as well as rutin (III) melting point 176^{0}c, 1.6%, tannin and some bergaptene has been isolated from the leaf of *F. carica*. (Watt and Breyer-Brendwijk 1962). They found the liquid fraction of the latex to contain 3.51% albumin, a trace of mineral salt, substances of a gummy and peptic nature and cradin (6.89%). Ficin, a proteolysis substance also isolated from the latex was effective in preventing the coagulation of milk and blood by digesting caseinogens and prothrobin respectively. (Watt and Breye-Brendwjik, 1962) Intravenous injection of 0.02 ml latex in the rat and 0.5 ml in the rabbit resulted in immediate death with symptom of capillary damage in the internal organs. Subcutaneous injection resulted in local necrosis and anaemia but oral administration was non-toxic (Watt and Breyer-Brandwijk, 1962).Abu and Mustapha (1964) reported that the leaves contain β-amyrin, lupeol and psovalen

The latex of this species is used for curing warts while a plaster of their dried leaves is used to "draw" pus from an abscess. It is a prevalent belief among the East Africans that eating of the dried fruit causes conception. The fruit is laxative and is used all over the world in domestic medicine as emollient and diuretic. The leaf is used in China as a local application to haemorrhoids (Watt and Breyer-Brandwijk, 1962).

2.4.5 *F. elegans*

Dalziel (1937) reported the use of the leaves of this plant as an ingredient in "agbo" infusion given to children in Lagos. Buds of the leaves known as "osorofunfun" are used for the cure of diarrhoea (Sofowora, 1979).

2.4.6 *F. exasperata*

The leaves are used in scraping ringworm patches while decoction of the leaves is given for stomach troubles (Dalziel, 1937). Boiled back is taken orally to reduce enlarged spleen Watt and Breyer-Brandwijk (1962) reported that the leaves contain an unusually high percentage of calcium silicate, which can cause intestinal inflammation in cattle and man. The leaves are used for polishing wood work. They also reported the use of the ash of the wood as a local application to lesions of leprosy, in some parts of tropical Africa. In central Africa, water in which the leaves have been soaked is instilled on to the eye in the treatment of ophthalmic conditions.

2.4.7 *F. globarata*

Murilo (1950) found that the latex of this plant had a proteolytic action on fibrin but it did not interfere with prothrombin, i.e. it prevents plasma coagulation. Peleaz et al. (1959) found the latex to be partially successful in eliminating 21.4% of trichuriasis (*Hymaenopsis nana*) and one case of *Ascaris lumbricoides*.

2.4.8 *F. glomerata*

Two different proteins were found in the latex of this species by Tampratip (1948), while Sen and Chawdhury (1971) isolated a new tetracylic triterpene tentatively named gluanol acetate, 13, 14β, 17B, H, 20α H-0-lanosta-8, 22-diene, 3 β -acetate in the leaves of the same plant. The fruit of *F. glomerata* was found to contain a compound also tentatively identified as 16, 13, 14 β, 17 β, (H)-lanosta-8, 22-diene-3 β -d and β sitosterol (Merchant et al., 1979).

2.4.9 *F. glumossa*

Dalziel (1937) reported that the bark of this plant to be used for dyeing cloth brick-red colour in Northern Nigeria. Toothache is treated with decoction of the leaves while in Eastern Sudan the bark is used in tanning and making cloth.

2.4.10 *F. gnaphalocarpa*

The leaves gave a positive test for flavonoids and sterols (Watt and Breyer-Brandwijk, 1962). The figs are succulent and fairly good to eat. Medicinally the bark is used in Senegal and Guinea in form of decoction while the latex is given to cure chest complaints (Dalziel, 1937). The leaves are good fodder given to goats, cattle and sheep.

2.4.11 *F. ingens*

The bark of this is found to contain tannins. The Zulus are reported to use decoction of the bark to increase milk yield in cows yielding very low quantities of milk and is also used in treating anaemia in human beings (Watt and Breyer-Brandwijk, 1962).

2.4.12 *F. itteophylla*

Adigun (1988) extracted from the bark of this species what is suspected to be glycosides of saponin type namely triterpene, steroidal alkaloids and saponin glycosides in yields of 2.05%, 0.15%, and 0.32% respectively. The young leaves are used as animal fodder while fresh pounded bark is applied to horses' swollen feet (Dalziel, 1937).

2.4.13 *F. lepreurii*

This tree is planted for shade in villages and sometimes as live fence. In Southern Nigeria, the latex is sometimes applied in treating guinea-worm sores (Dalziel, 1937). Kokwara (1976) reported that chewing the bark of this plant induces lactation in humans.

2.4.14 *F. natalensis*

The bark of this plant is used as galactagoue and influenza remedy in Tanzania. In Tanganyika the root is used for treating colic pains. The Zulus are reported to make mats and ropes out of the bark. (Watt and Breyer-Byandwijk, 1962).

2.4.15 *F. ovata*

The inner bark of this species is sweetish to taste and is chewed with kola nut). The latex is resinous and is used as trap for birds (Dalziel, 1937).

2.4.16 *F. pantoniana*

Analysis of this plant gave the first known flavonoidal alkaloids fascine ($C_{20}H_{19}NO_4$), with melting point of 250^{0}C and the less abundant isoficine with a melting point of 168^{0}C (John et al., 1965)

2.4.17 *F. platyphylla*

The bark of this plant is used in Sudan and Upper Nile as tanning material. Fibre is extracted for cordage or weaving, the fruit is edible (Dalziel, 1937).

2.4.18 *F. pretoriea*

Watt and Breyer-Byandwijk, (1962) reported it to give a positive test for flavanoids and sterols and also, that the Maiyika of Southern Rhodesia used it as a remedy for sterility, the root being chewed with water.

2.4.19 *F. racemosa*

Trived et al. (1969) extracted from the leaves of this plant a fraction rich in glycosides. This extract was found to exert hypotensive and vasodilatory effect on anesthetised dog and a direct cardiac depressant action. It did not show any significant effect on the intestine of rat and rabbit, uterus of rat and rectus abdominus of frog. They did not observe any change in the behavioural activity or any sign of acute toxicity. The main phamarcological effects are hypotension and cardiac depression. This drug has inhibitory effect on the heart.

2.4.20 *F. religiosa*

Malhotra et al. (1960) found the extract of the bark of this plant to contain glycosides, resins and traces of alkaloids. They found that the extract relaxes the intestine of rats, guinea pig, rabbits and dogs, and the uterus of rat. Ambike and Rajarama-Roa (1967) isolated β-sitosterol-D-glucoside from the bark. The isolated β-sitosterol-D-glucoside was found to have hypoglycaemic effect in mice which compared favourably with tolbutamide. It was also found to produce CNS stimulation, convulsion and reversal of reserpine depression in mice at toxic level which was found to be 62mg/kg of body weight, when administered via the peritoneal route. Ray and Pal (1967) found the leaves to have intermediate oestrogenic activity which they found free oestrone to be the source of activity.

2.4.21 *F. salicifolia*

The fruit of this plant was found to contain psolaren, bergapten and scopoletin in the coumarin and β-sitosterol in the non saponifiable matter (El- Gamal et al. 1975).

2.4.22 *F. septica*

Two alkaloids were isolated from this plant and identified as (-) tylophorin and (±) tylocrebrine, a third one was named septicine ($C_{20} H_{19} NO_4$) and the propose structure 6, 7,-bis (3,4-dimrthyoxy phenyl)-6,7-dehydro indolizidine. This is reported to be the first infused indolizidine found occurring naturally (Russell 1963). Saxton (1971) confirm the structure proposed for septicine.

2.4.23 *F. sycomorus*

The leaf, stem, fruit and root give positive test for flavonoid and sterol (Watt and Breyer-Brandwijk, 1962). The fruits are large and edible, while the leaves are fed to cows to increase the flow of milk. A decoction of the bark and the latex are used for chest conditions and cough while the juice is used as a remedy for inflammations. In East Africa the bark is used as anti diarrhoea remedy especially by the Masai, a use also in other parts of tropical Africa (Kwakora, 1976).

2.4.24 *Ficus thonningii*

The bark in decoction or infusion is used in Guinea for sore throat and cold while in Liberia it is ground up and mixed with gun powder as a dressing for cuts and wound (Daliziel,1937). Watt and Breyer-Brandwijk (1962) reported that the root of this plant is an indigenous galactagogue for cows in Tanzania. They also reported that the figs are edible and used in brewing, while bark is used in Tangayika and Congo for making cloth.

2.4.25 *Ficus vogelii*

The stem, leaf and fruit give positive tests for sterol. This plant was once known as the source of rubber of poor quality (Dalziel, 1937). In tropical Africa the latex is used as antiseptic and tonic and as a local application to dental caries. An infusion of the bark is used for leprous ulcer and as a stomachic, astringent, anti diarrhoeic and anti-dysenteric, (watt and Breyer-Brandwijk, 1962).

2.5 Toxicity

Some *Ficus* species have been reported to have toxic effects when fed to farm animals. For instance, Rajan et al. (1986) reported 2 cows dying 15-20 days after eating leaves of *Ficus tsiela*. When examined, severe necrosis was found to be most important pathological changes in the liver and kidney. Clinical signs observed were salivation, muscular twitching, nystagmus, intermittent convulsion and anorexia which started within 48 hours after the animals had consumed the leaves. Nair et al. (1985) carried out an experiment in which they fed 3 calves weighing 23 to 37 kg with fresh leaves of the same plant. They observed the calves to develop muscular tremor, convulsion and the calves later died over a period of 3 to 12 days after consuming the leaves. Examination of the dead calves revealed necrosis of the liver, kidney, myocardium and abomasal ulceration.

Latex of *F. carica* has strong necrotic action on the skin (Uman, 1945 cited by Watt and Breyer-Brandwijk,1962); and when alcohol fraction of it was injected intravenously, it was found to cause anaemia but has no effect when given orally.

Apart from these studies, authentic information regarding toxic properties of the *Ficus* species is scarce. Most of the information regarding toxicity is speculations by herdsmen or traditional medicine men- For example; fruit of *Ficus bengalensis* which is edible to the peasant Indians is said by the local people to be toxic to horse (Chopra et al., 1965). The excessive use of the latex of *Ficus capensis* is reported by Kokwara (1976) to be toxic to humans. Abortion in animals is caused by *F. semicordata* and *F, hispida* while hair loss, and skin disease are caused by *F, clavata* (Joshid and singh, 1990) Decreased milk yield was found in animals fed *f. semicordata, F, hispida, F, glaberina* and *F, roxburghii,* while *F, lacor* and *F. roxburghii* cause disphagia. *Fi semicordata* and *F, nemoralis* were found to cause haematuria (Joshi and gh, 1990). Herdsmen around Shika (Kaduna state, Nigeria) cautioned agair eeding pregnant animals with *F, thonningii* as they believed it causes abortion in small ruminants, and blindness in cows.

2.6 Oestrous cycle in the ewe

The oestrous cycle is the reproductive cycle of most adult female mammals and is a sequence of oestrus periods with regular intervals Oestrus is the period during in which the female will accept mating by the male. The oestrous cycle is composed of a long luteal phase which extends from the formation of corpus luteum CL after ovulation, until its regression at the end of the cycle. A short follicular development phase follows, in which the follicle develope rapidly; this begins with the regression of the corpu luteum (CL). The luteal phase of the ewe lasts 14 to 15 days while the follicular phase last between 2-3 days (Thibault and Levasseur, 1974).

The length of the oestrous cycle and the time of ovulation vary in relation to internal and external factors. Thibault and levasseur (1974) reported that there is an increase interval between oestrus and ovulation with increase in number of ovulation while sexual stimulation reduces the length of oestrus in the ewe.

The normal oestrus cycle length in the ewe is reported by Terrill (1974) to range from 14 to 19 days with a mean dura[illegible] of 17 days. Also, the average duration of oestrus was found to be 24 to 48 [illegible]urs and is usually observed over a range of 12 to 41 hours after the onset of [illegible]trus. However, Robertson (1977) reported that the most common breeds of [illegible]ep have a mean inter-oestrous interval of

16.5 to 17.5 day with oestrus duration of about 30 hours and that ovulation occurs 24 to 27 hours after the onset of oestrus. Oestrous cycle length in Yankasa sheep ranged from 13 to 17 days with a mean of 15 days (Kuteyi 1978 cited by Adu and Ngere, 1979). Igono et al. (1982) reported that the oestrous cycle length in Yankasa sheep ranges between 14 to 18 days with a mean of 16.4 ± 0.53 days in the hot season. They also observed cycles beyond 19 days. They reported that the duration of oestrus ranged from 8 to 48 hours with a mean of 33.6 ± 5.8 hours. Osinowo and Adu (1986) reported that oestrus cycle length in Nigerian breeds of sheep is 16 to 17 days with oestrus duration of 1 to 2 days and that the ewes ovulate about 16 hours after the onset of oestrus. Work by Oyedipe et al. (1986) showed that mean oestrous cycle length of Yankasa sheep to be 18.1 ± 1.7 days with a mean duration of oestrus of 25 ± 2.2 hours.

2.7 Endocrine Control of Oestrous Cycle

Hormonal interactions are responsible for the regulation of the reproductive cycle in all domestic animals. Releasing hormones from the hypothalamus are secreted into the hypothalamic-hypophyseal portal system. These then stimulate specific cells of the adenohypophysis resulting in the release of gonadotropic hormones (LH, FSH and Prolactin) into the circulation and transported to the ovary where they stimulate follicular development, oestrogen secretion, ovulation and corpus luteum formation (Short 1972; Nalbandov, 1976).

A few days prior to oestrus, several follicles begin to develop slowly until the follicular phase of the cycle which begins approximately 48 hours before the onset of oestrus. Robertson, (1977) reported that rapid development of the follicle that will rupture at ovulation begins 18h after the onset of oestrus or 8 to 10h before ovulation. The growth of these follicles is primarily under the control of FSH but the concentration does not rise when follicles are developing rapidly. The ripening of the ovulating follicles occurs during the peak concentration of LH and FSH.

As the follicles mature, oestrogen is synthesized and secreted by the theca internal under the influence of FSH and LH. The highest level of oestrogen occurs during the late follicular phase. Scaramuzzi and Land (1978) reported the peak concentration of oestrogen in the plasma of Finnish landrace and Scottish Blackface ewes to be a day before oestrus with values of 3.1±0.06pg/ml and 2.8±0.6pg/ml respectively. Study by Pant et al. (1977) however, showed that oestrogen levels in the plasma of Clun forest, ewes start to rise 12 to 14h before the onset of oestrus from the values of 11.2 ± 0.3pg/ml during luteal phase to 21.1±2.0pg/ml at 8 h before the onset of oestrus.

Oestrus is induced by the effect of the oestrogen on the central nervous system (CNS). This has been shown experimentally by introducing implant containing small estradiol-17β into the hypothalamus (Robertson, 1977). Progesterone has been found to have a synergistic effect with oestrogen in inducing oestrus (Clark et al., 1977). Increasing level of oestrogen also exert a positive feed-back on the hypothalamic-hypophyseal axis resulting in the release of peak levels of LH, FSH and PRL during oestrus (Short, 1972; Clark et al. 1977; Jöchle and Lamond, 1980). Studies by Pant et al. (1977) showed that the concentration of LH in the plasma begins to rise 6 hours after the onset of oestrus reaching peak values of 73.3±7.4ng/ml at about 9.0h. The concentration then declines sharply reaching low values of 20.59±0.9ng/ml and 19.7±.54h after oestrus. Two distinct peaks of FSH were however, observed in this study, the first peak coinciding with LH peak with a maximum value of 171.0±35.0 ng/ml. The peak levels of LH and FSH secreted at oestrus are responsible for the rupture of follicle and release of ovum/ova which occurs approximately 24 h following LH peak.

Following ovulation, the granulose cells in the cavity left by rupture of the follicle grow and divide, forming a solid body called the corpus luteum (CL) under the influence of the gonadotropin. The CL is capable of secreting progesterone and it attains its maximum morphological size and functional activity on day 7. The CL is highly vascularised, receiving about 97% of the total cranial blood (Short 1972; Niswender et al., 1974). This transformation or luteinization of the granulose cells is accompanied by the synthesis and secretion of progesterone from the basal concentration of 0.2ng/ml. A discernible rise in the peripheral plasma concentration of progesterone occurs around day 4, reaching a peak of 2 to 4ng/ml by day 7 then rapidly declines on day 15 i.e. about 36h before the onset of the next oestrus (Robertson, 1977). Cyclic pattern of plasma progesterone concentration was observed by Pant et al. (1977). The progesterone concentration was lowest during oestrus and 2 days after oestrus with values of 0.25ng/ml±0.01ng/ml. The concentration showed a marked rise from day 5 (1.6±0.14ng/ml) to a peak of 3.7±0.28ng/ml between day 7 and 13 followed by a decline 36h preceding the next oestrus. Plasma progesterone concentration in Yankasa sheep ranged from non- detectable at puberty to a peak of 1.86±0.38ng/ml at mid-cycle and about 0.12ng/ml during subsequent oestrus (Oyedipe et al., 1986).

Once the CL has developed completely and the secretion of progesterone is highest, the CL continues to function only for a few days, unless the ewe becomes pregnant. In the non-pregnant ewe, 13 to15 days after ovulation, the production of progesterone diminishes rapidly and the corpus luteum begins to regress (Short, 1972; Robertson, 1977). Regression of the CL was found to be under the influence of prostaglandin F2α (PGF2α) which is a luteolytic substance synthesized and secreted by the endometrium of the uterus (Short, 1972; Nalbandov, 1976; Henrick and Mayer, 1977). Increased levels of PGF2α have been found in the uterine venous blood of sheep in 15 to 16 days of the normal oestrous cycle (Bland et al, 1971). Progesterone secreted by the CL stimulates the endometrium of the uterus to syntheses and store PGF2α (Wilson et al, 1972) but the rapid release that occurs on day 15 resulting in luteolysis remains to be explained. However, evidence has suggested that oestrogen may be involved in the release of PGF2 α from the uterus. Oestradiol-17β, if given in a large enough doses will induce luteolysis when given toward the end of the oestrous cycle and therefore, is a prime suspect as the stimulator of the release of PGF2α from the uterus (Robertson, 1977).

Once luteal regression begins it occurs rapidly. The CL essentially ceases to be functional within 12 to 24h following onset of its regression and the ewe is ready to repeat the oestrous cycle in its entirety after CL regression (Niswender et al 1977).

2.8 Conception in the Sheep

Copulation occurs before ovulation in the sheep and therefore, spermatozoa are present in the oviducts by the time of ovulation. At copulation, the semen is deposited into the vagina and travels through the reproductive tracts at 4cm/min in the ewe (Terrill, 1972). The sperm tends to survive longer in the cervix up to 3 days, 12h in the vagina, and up to 30h in the uterus and oviduct. Sperm transport is aided by contractility of the female tract although sperm motility is important in the cervix (Lightfoot and Restall, 1971).

Following ovulation the egg passes into the fallopian tube aided by the movement of the fimbriae of the infundibulum. Fertilization occurs in the lower region of the ampulla of the oviduct within hours after ovulation. The egg may remain viable for 10 to 25h if unfertilised, but the chances of abnormal fertilization increase with increase age of the egg or sperm (Terrill, 1972; Robertson, 1977; Anderson, 1977).

When the fertilized egg has reached the morula stage on day 4, it passes through the utero-tubal junction into the uterus. An elevated level of plasma oestrogen occurs at this time (obst et al, 1972) cited by Robertson, 1977) the embryo of the sheep gets implanted usually on day 12 of the pregnancy with a functional CL actively secreting progesterone which is required to maintain pregnancy (Rowon and Moore, 1967, cited by Robertson, 1977).

2.9 Effect of Natural Toxins on Sheep Reproduction

Reproductive efficiency is one of the most important economic factors of livestock production. This complex endocrinological process that involves events of oogenesis, spermatogenesis, fertilization, implantation, embryonic and foetal development may be sensitive to many factors such as:- dietary factor essential for normal reproduction, disease, heredity, management, environment and toxic dietary factor (James et al, 1992); of all these factors, the toxic dietary component have hitherto received the least attention. There are many plants containing a variety of toxic agents and so different mechanisms of toxicity are involved.

Natural toxins are known to have adverse effect on fertility. The term fertility here could mean the overall production rate of groups of individual animal. With groups, it could be referred to as herd fertility while with individuals it could refer to male or female fertility. In females, it described the ability to produce fertile egg or become pregnant following mating by a male. Where as in the males, it describe the ability to produce viable sperm and to be able to get a female pregnant. Many toxins have adverse effect on embryonic and foetal development following fertilization thus leading to embryonic and foetal death, abortion and neonatal death. Some toxic agents may affect reproduction in livestock via indirect means such as reduced growth or by damaging other vital organs of the body.

Information regarding toxic effect of *Ficus* on reproduction is not available but studies have been carried out on many toxic plant that specifically affect reproduction though sometimes the toxic agents could not be identified, However the known toxic agents are: Steroid alkaloids like jervine and cydoamine contained in *Veratrum californicum* (Binns et al, 1963). Quinolizidine alkaloids like anagyrine contained in *Lupinus spp.*, piperidine alkaloids like anabasin contained in *Nicotiana spp.*, and indolizidine alkaloids like swansonine in *Astragalus spp*, others are oestrogen and oestrogen like compounds like coumerstrol and genistein found in *Astragalus spp.*, *Trifolium spp.*, *Medicago sativa* (alfalfa), orchard grass and rye grass. Ergot peptide alkaloids (ergovaline) from fungus-infected fescue hay, glucosinolate in *Brassica* and selenium from seleniferous plants (Barret et al., 1965; James et al, 1992).

These toxic agents are found to affect nearly all reproductive processes. Oestrogenic legumes have been associated with reduced conception rates;

increased embryonic loses in the first 20 days of gestation and also foetal losses from day 60 to term (Davis et al., 1970). Turnbull et al., (1966) reported that the conception rate was significantly related to the content of isoflavone in the oestrogenic varieties of subterranean clover. Sheep grazed on locoweed (*Astragalus spp.*) over a period of 30 days were reported to have marked decline in libido, fertilization and implantation, Spermatogenesis and oogenesis were also inhibited (James and Van Kampen, 1971 cited by James et al., 1992). Ewes on endophyte infected fescue exhibited delayed conceptions after introduction of the ram (Potter and Thomson, 1992). This delayed conception was attributed to embryonic mortality and/or to delayed onset of oestrus rather than to fertilization failure in ewes on infected fescue, Gossypol which is found in cotton seed has been shown by Kennedy et al, (1983) to interfere with testicular development in rams and bulls.

Natural toxic agents have been shown to cross placental membrane and interfere with embryonic and foetal development (Binns et al., 1963; Keller and Sterwart. 1987; Panter et al.1990). Piperidine-containing plants like *Conium maculata*, *Nicotiana spp.* and *Lupinus spp*, were found to induce foetal abnormalities when consumed during specific periods of gestation (Panter et al., 1990). Facial, skeletal and tracheal defects have been found in lambs from ewes consuming *veratrum californiucum* on gestation days 14, 27, 30 and 33 (Binns et al., 1963, Keller and Stewart, 1987). Locoweed was shown to slow foetal heart rate with resultant changes in placental function, foetal death and abortion. *Astragalus* *spp.*, *Gutierrezis spp* and *Pinus spp,* all have potential of interrupting pregnancy if grazed by cattle and sheep (James et al., 1992).

2.10 Physiological Responses of Sheep to Natural Toxic Agents

Studies on the physiological responses of sheep to natural toxic agents are very scarce. Bolt et al (1982) however reported that plasma prolactin (PRL) was reduced rapidly in the ewes on endophyte infected fescue hay compared to those on orchard grass. The reduction was not associated with altered pituitary PRL and therefore, involved impaired secretion rather than synthesis. In addition no difference was observed in either plasma or pituitary Leutalising hormone (LH), follicle stimulating hormone (FSH), growth hormone (GH) and thyroid stimulating hormone (TSH).

Some studies on the bovine have however shown the physiological response to some of these toxic agents, especially in cases of abortion. Ergot peptide alkaloids from infested fescue were found to have vasconstrictive effects; in the bovine, they are also able to stimulate contraction of the gravid uterus leading to spontaneous abortion (Potter and Thomson, 1992). Study by Panter et al, (1992) showed that there was elevation in the levels of progesterone, oestradiol and cortisol in cow fed pine needles (PN) (*Pinus spp.*) to induce premature parturition. The concentration of the oestrogen by day of parturition was found to be similar to those in control. The workers suggested that PN induced mechanism was probably through its action on the source of progesterone. Ford et al. (1992) speculated that PN-induced premature parturition in cows occur by reducing the secretion of catechol oestrogen (oestrogen metabolites produced by the placenter and (or) endometrium which inhibits extracellular Ca^{+2} uptake) by gravid uterus thus, increasing uterine tone. Studies by Gu et al. (1990) found that gossypol interfered with normal *in vitro* development of bovine embryos and *in vitro* synthesis of progesterone by luteal cells. Although, these studies are few and inadequate to generalize the effects, of all natural toxic agents on the physiological responses in sheep, they have at least indicated that some adverse effects of these agents exist in sheep reproduction.

CHAPTER 3

3. Materials and Methods

3.1 Location of the Experiment

The study was undertaken at the National Animal production Research Institute (NPRI). Shika, Zaria, Nigeria. Shika is located on latitude 11^0 12'N and longitude 7^0 33'E at an altitude of 610m above sea level. The climate is sub-humid and the vegetation is Northern Guinea Savannah. Mean maximum temperature is between 27^0c in the rainy season and 37^0c in the dry season. The rainy season falls between late April and early October with mean annual rainfall of about 1100 mm. Fodder is generally scarce and of low quality in the late dry seasons and early wet season while it is in abundance and of relatively good quality in the late wet season and early dry season.

3.2 Identification of *Ficus* Species

Prior to the commencement of the experiment, all *Ficus* species growing within the premises of NAPRI were identified. Identification was carried out with the help of local people when vernacular (Hausa) names were provided. Photographs of trees, leaves, and in some cases fruits were taken and height of some of the trees estimated with the help of an 8 m pole. Colour of truck, aerial roots and habits of the plants were observed. Samples of leaves and fruits were collected to study some morphological features whiles some were labeled and taken to the Biological Science Department Herbarium, Ahmadu Bello University, Zaria, for identification or confirmation.

3.3 Proximate and Mineral Momposition of *Ficus* Species Found in NAPRI, Shika, Zaria

Leaf samples were collected in polythene bags from all identified species. These were labelled, sealed and taken to the laboratory for analysis of DM, Nitrogen, ether extract, NDF and ADF, NDF and some minerals (Ca, P and Mg). Gross energy was not analysed due to faults in the bomb calorimeter. These analyses were based on ADAC (1970) methods and on dry matter basis. The crude protein was calculated by multiplying the nitrogen value by 6.25

3.4 Experiment Animals

Thirty-eight Yankasa ewes aged between 2-3 years with weights ranging from 22.5 to 30.1 kg were used for the experiment. These animals were chosen from among the flock of sheep in the Sheep Breeding Project, NAPRI. Prior to the experiment they were managed under the semi-intensive systems which involved grazing on improved pastures for 6-8 hours daily. They were supplemented with 15% crude protein concentrate at the rate of 300 - 500 g/day/head depending on the physiological status of the animals. This concentrate was given in the morning before the animals were sent out to the paddock to graze. Water was provided *ad libitum*. The animals were dewormed at the beginning and the end of the dry and rainy seasons and also treated for ectoparasites. They were housed in well ventilated pens at night.

3.5 Experimental Design and Procedures

The design of the experiment was completely randomized design with 4 treatments and 10 replicates. The experiment commenced on the 16th of April 1993 with synchronization of all the experimental animals using progestagen impregnated vagina sponges (Veramix, Upjohn). Each sponge contained 60mg medroxy progesterone acetate and was inserted intra vaginally for 12 days. The sponges were withdrawn on the 12th day after which the animals were weighed and randomly allocated to one of the four feeding treatments.

Table 2: Expeimental Forage Diet Composition (% by DM Weight)

Groups	*F. thonnigii* Leaves	*D. smutsii* Hay
A	-	100
B	25	75
C	50	50
D	75	25

The experimental feed consisted of *F. thonnigii* fresh leaves and *Digitaria smutsii* hay as basal diet. The feeding treatments were 0, 25, 50 and 75% of the fresh leaves of *F.thonningii* replacing *Digitaria smutsii* hay for groups A, B, C, and D respectively. The roughage was given to groups at fixed daily rate of 3% liveweight. All the animals were fed 15% CP concentrate at a fixed daily rate of 1% liveweight every morning. The concentrate was completely consumed before the basal diet was offered. This feeding treatment started on the day the sponges were withdrawn and lasted for 60 days. Water was given *ad libitum*. The following parameters were studied:

- Feed intake
- Weight gain
- Frequency of oestrus (F0)
- Serum progesterone profile
- Oestrous cycle length (OCL)
- Conception rate (CR)
- Lambing rate (LR)

In the 2nd week of the experiment 2 animals were removed from group C. this was because one of the ewes lambed while the other was sick and therefore culled.

3.5.1 Feeding and Weighting of Animals

The feeding experiment lasted 50 days with a 10 day adjustment period. Feed refusal from each pen was weighed the following day to determine intake. Individual average daily intake was obtained by dividing the group intake by the number of animals in the group. The animals were weighed every 10 days for the duration of the feeding trial. The average daily gain (ADG) was obtained by differences of the initial and final weights divided by the number of days the animal of days were fed.

3.5.2 Monitoring of Oestrus and Oestrous Cycle

Heat detection started on the day the sponges were withdrawn. Two intact aproned rams, harnessed with crayons were used for checking oestrus. The ewes were checked twice daily for oestrus at 0800 and 1500h. Three cycles were monitored and oestrus detection started 14 days after the onset of the previous one and lasted for 7 days. Frequency of oestrus was determined as the number of times an animal was picked on heat during the experimental period. OCL was determined as the interval from one oestrus to the next for cycle with no intervening anoestrus.

3.5.3 Mating of Ewes

At the 4th oestrus, the ewes on heat were pen mated at the joining rate of 2 ewes to a ram. Non-return rates were obtained 21 days after breeding. Those animals that did not return on heat on day 21 after mating were considered pregnant. The number of ewes that lambed at the end of the lambing season was recorded and lambing rate was obtained as percentages of ewes lambing over ewes bred.

3.5.4 Blood Sampling

Blood samples (10ml) were collected from each of the experimental animals by jugular puncture 3 times weekly; on Mondays, Wednesdays and Fridays throughout the experimental period (60days). The blood samples were refrigerated at 4^0C and the serum decanted 24 hours after collection and stored at -20^0C until analysis. Sera samples of 3 ewes from each feeding treatment were randomly taken and analysed for progesterone, Solid-phase radioimmunoassay procedure (IAEA/RIA/kit) was used to determine the serum progesterone level in 100μl aliquot.

3.5.5 Data Analysis

The data on serum progesterone, feed intake, weight gain and oestrous cycle length were analysed by least-squares method using the Harvey Computer Packages (Harvey, 1990). Data on frequency of oestrus, lambing and conception rates were analysed by chi-square method.

CHAPTER FOUR

4. Result

4.1 Identification of *Ficus* Species

Plates 1-6 are pictures of some of the species found in Shika. Eight species were identified, namely *F.capensis, F gnaphalocarpa* (Plate 1&2), *F .Ingens, F. Itteophylla* (Plate 3 & 4), *F. ovata* (Plate 5), *F. platyphylla* (Plate 6 & 7), *F. polita* (Plate 8) and *F. thonningii* (Plate 9 & 10). The most abundant species within the institute's premises was *F. thonningii.* This was followed by F. *gnaphalocarpa and F. platyphylla* (Table 3).

Table 3 *Ficus spp.* found within the Premises of NAPRI

Species	No. of Obsevation	%
F. capensis	1	4
F. gnaphalocarpa	6	24
F.injes	1	4
F.itteophylla	2	3
F.ovata	2	8
F.platyphylla	3	12
F.polita	2	8
F.thonningii	8	32
Total	**25**	**100**

Generally, these species are recognized by their milky latex, aerial; roots and their fruits. All the identified species are trees with heights ranging from 6 to 15 m. aerial roots were observed in *F. itteophylla* and *F. thonninagii.* The colours of the trunk in all the 8 species ware grey or black with the exception of *F. platyphylla* which had a distinctive rusty colour. Leaves were generally ovate in shape with entire margins. They were simple and alternate in arrangement. *Ficus* *itteophylla* had the smallest leaves while *F. platyphylla* had the largest leaves (Table 4).

The fruits commonly referred to as figs were swollen receptacles with florescent flowers arranged within it in all the species. They were either hairy or hairless and mostly ovoid in shape (Table 4). They ranged in size from 6 to 45 mm

Plate 1 *F. gnaphallocarpa* tree

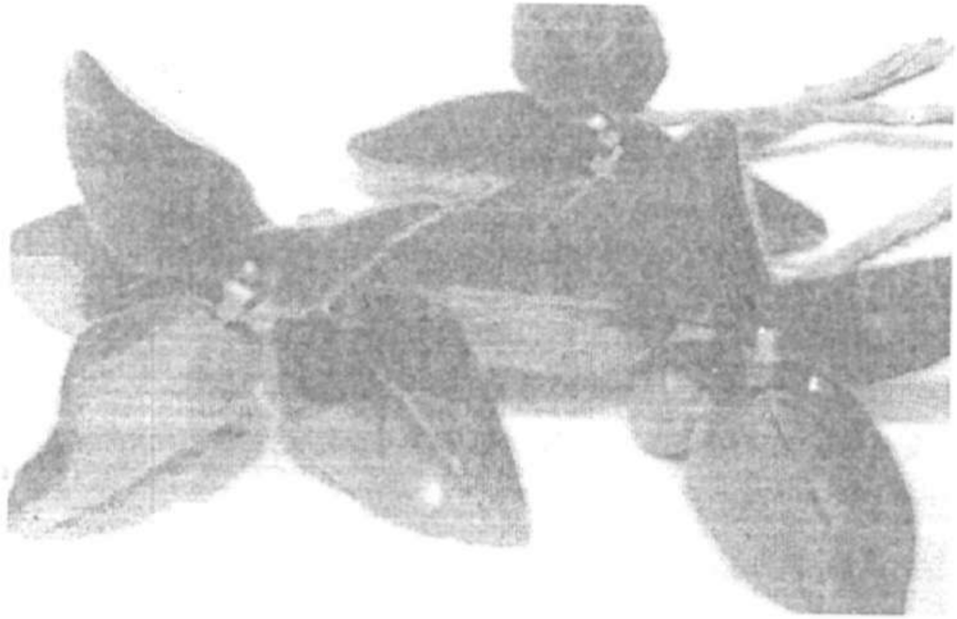

Plate 2 *F. gnaphallocarpa* leaves

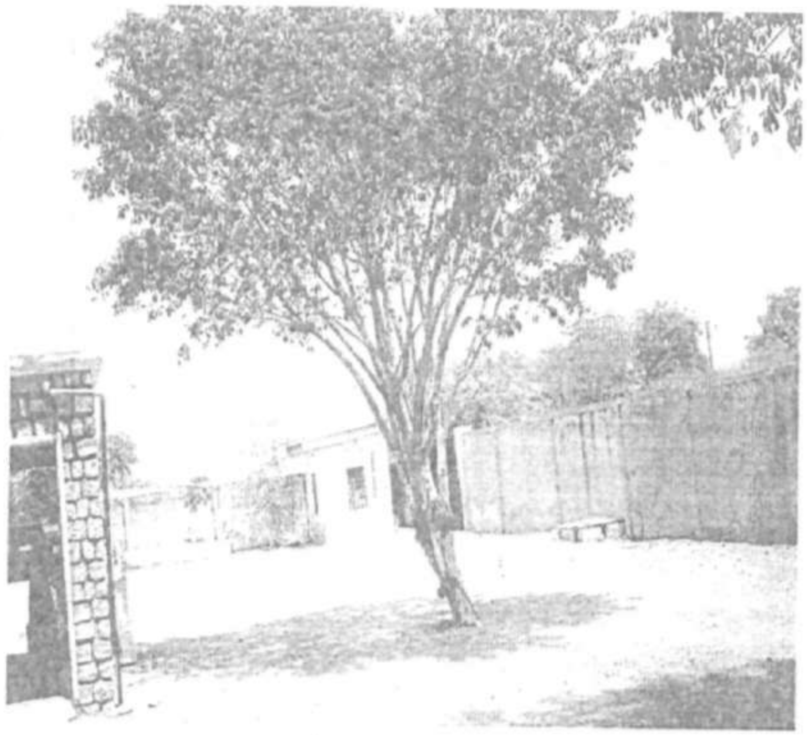

Plate 3 *F .itteophylla* tree

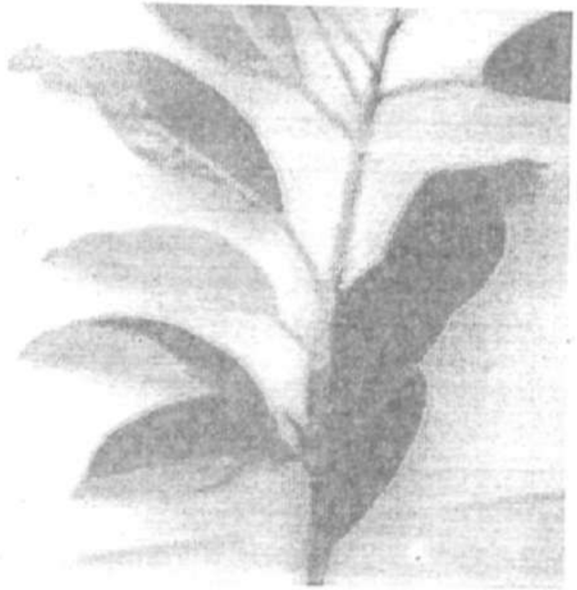

Plate 4 *F .itteophylla* leaves

Plate 5 *F. platyphylla* tree

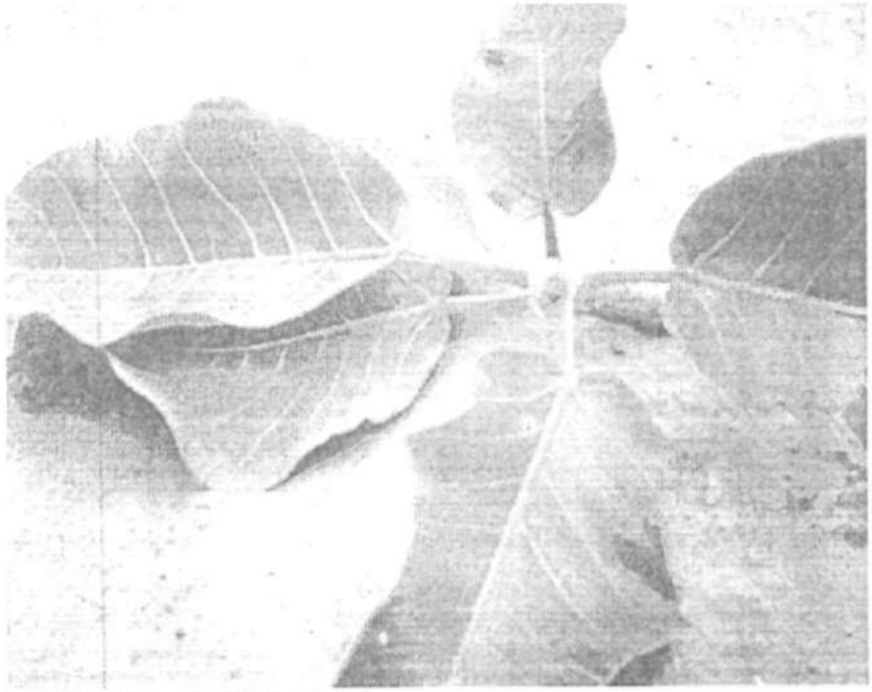

Plate 6 *F. platyphylla* Leaves

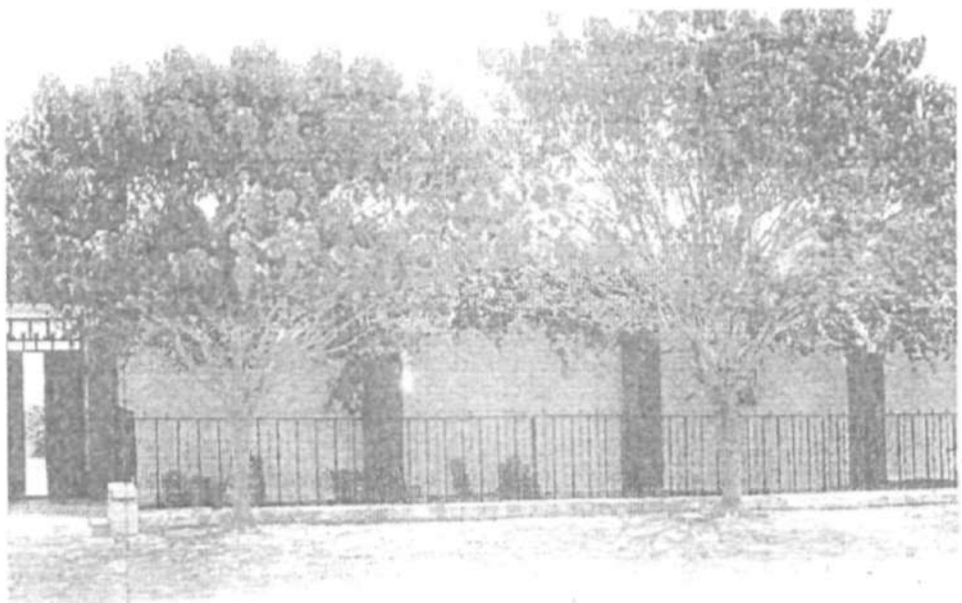

Plate 7 *F. polita* tree

Plate 8 *F. polita leaves with new fruits*

Plate 9 *F. thonnigii* tree

Plate 10 *F .thonnigii* leaves with fruits

Table 4 Morphological Features of Some *Ficus spp.* Found in Shika, Zaria

	FEATURES		
Species	Leaf Size (CM)	Leaves	Fruits
F. capensis	A= 7.5-15 B=3.3-9.9 C= 1.5-5.1	Ovate with entire margin, obtuse apex and rounded base. The surface is glabrous.	Pubescent, borne in cluster on trunk and branches. May be globous or ovoid in shape. The diameter ranged between 23-40mm
F. gnaphallocarpa	A=5.2-10.8 B= 4.1-6.3 C=1.2-3.9	Ovate with entire margin; acute apex and turnicate base. Upper surface rough and hairy.	Densely tomentose, no marks on the surface, borne singly on branchlets and branches. Ovoid in shape 36-45mm in diameter.
F. ingens	A=3.5-15 B=1.0-1.7	Ovate with rounded base, entire margin and acuminate apex. Upper surface glabrous lower surface pubescent.	Densely tomentose, figs borne on branchlet. Globous in shape 7-11mm in diameter.
F. itteophylla	A=5.7-11.6 B= 2.4-4.3 C=1.3-3.2	Lancolate with rounded base and apex, margin entire.	Densely pubescent, borne in cluster on branchlets. Globous, 6-11mm in diameter.
F. ovata	A=7.2-19.5 B=4.1-6.6 C=1.5-5.1	Oblong or ovate with entire margin, cordate base and acuminate apex. Non hairy with dark upper surface and light lower surface.	Borne in twos directly on the axis of the leaves with white spots; 13-15mm in diameter.
F. platyphylla	A=15-40 B=7-28 C=3-12	Ovate with entire margin, cordate base and acute apex. Hairless, veins tinged with pink.	Borne on branches, hairless. Obvoid in shape. 35-45mm in diameter.
F. polita	A=7-15 B=5-12 C=1.5-3.5	Oblong or ovate with entire margin, rounded base and acuminate apex. Hairless and shinny.	Borne in cluster toward the tip of the branchlets, pubescent, 9-12mm in diameter
F. thonningii	A=4-17.5 B=3-9 C=2-4	Ovate with entire margin, rounded base and obtuse apex.	Borne in twos directly in the axis of the leaves. Denxely tomentose, 6-10mm in diameter.

Key
A= Leaf length B= Leaf width C= Petiole length

4.2 Proximate and mineral composition of the leaves of *Ficus* species found within the premises of NPRI

Chemical composition of the eight identified *Ficus* species is presented in Table 5. The mean % dry matter content of all leaves from the study materials was 34.0±3.13, with the highest % DM content (48.5) recorded for *F. gnaphalocarpa* which nearly doubles that of *F. ingens* (28.0). The least crude protein (CP) content was found in *F. capensis* (7.13%) and highest (12.6%) in *F. itteophylla.* Overall mean for the 8 species was 9.60±0.63. Fibre content was moderate, acid detergent fibre (ADF) ranged from 25.1% (*F. itteophylla)* to 36.9% (*F. capensis* and *F. thonningii*) with mean of 33.1±1.73%. Mean lignin content for all the study materials was 5.3±0.59 and ranged from 3.51% to 8.64% for *F.capensis* and *F thonningii* respectively. The percent ether extract (EE) ranged from 2.15 *(F. gnaphalocarpa)* to 6.65 *(F. itteophylla),* with overall mean of 3. 52±0.68. These species were found to have Calcium content ranging from 1.08% *(F. platyphylla)* to 2.82% *(F. ovata*) with overall mean of 1.58±%. Phosphorus content ranged from 0.10% to 0.22 which is low. A ranged of 9:1 Ca:P ratio was obtained.

Comparing *F. thonningii* with the others, % DM (35.6%) is similar to the overall mean (34%) but lower than the 48.5% which is the highest DM value. The CP content was high (10.93%) and is 2nd to the *F. itteophylla* (12.56%). However the highest acid detergent fibre content (36.90%) (ADF) and the lowest lignin content (3.51%) was recorded for this species. Ca:P ration is also 9:1

Table 5 Proximate Composition of Some *Ficus spp.* Found in NAPRI (%DM)

Species	DM	CP	EE	NDF	ADF	Cell.	Lignin	Ash	Si	Ca	Mg	P
F. capensis	34.3	7.13	3.40	47.0	36.9	27.4	8.64	13.5	0.90	1.24	0.15	0.18
F. ingens	28.0	9.94	2.92	38.0	35.9	30.2	4.60	13.0	1.09	1.33	0.20	0.22
F.itteophyla	40.0	12.6	6.65	36.3	28.7	23.3	3.72	13.2	1.76	2.03	0.25	0.22
F. gnaphalocarpa	48.5	8.75	2.14	41.2	35.3	14.4	5.76	14.4	1.08	1.30	0.05	0.15
F. ovata	31.1	8.82	3.73	37.2	30.9	25.4	6.45	11.1	1.29	2.82	0.15	0.17
F. platyphylla	35.6	8.44	2.25	37.7	33.2	23.3	5.43	18.0	1.53	1.08	0.20	0.10
F. polita	40.0	10.8	-	33.2	25.1	18.1	4.68	14.3	1.55	1.33	0.15	0.17
F. thonningii	35.8	10.4	3.56	49.1	36.9	31.9	3.51	11.7	1.50	1.54	0.24	0.16
Mean	34.0	9.60	3.52	39.7	33.1	25.8	5.35	13.6	1.34	1.58	0.17	0.18
SD	3.15	0.36	0.68	2.12	1.73	1.54	0.59	0.79	0.10	0.22	0.03	0.05

4.3. Performance of *Yankasa* ewes fed different levels of *F. thonningii* leaves.

4.3.1 Feed intake and average daily gain (ADG)

Result of forage intake and average daily gain of the ewes throughout the feeding experiment are presented in Table 6. Intake of browse by the animal rose significantly (P<0.05) from those in group B to those in group D. Animal in group B, C and D consumed 205 g/d, 407 g/d and 511 g/d corresponding to 0.75, 1.5 and 1.82% live body weight (LBW) for the 3 groups respectively. Total forage intake was highest for group D (719 g/d) and lowest in control group (622 g/d). Total DM intake (forage plus concentrate supplement) for the animal ranged from 3.24 to 3.69% live body weight.

Average daily gain (ADG), different significantly between treatments (P<0.05). Animal in group B gained the highest weight (68.00 g/d). This was followed by animals in groups C, A, and D, with mean ADG values of 57.50, 48.00 d and 46.0 gd^{-1} respectively. Overall ADG for all the experimental animals was 54.87 ± 0.35 gd^{-1}.

Table 6: Mean Daily Feed (DM) Intake (g) and Live Weight Changes (kg) of Yankasa Ewes Fed Diets Containing Varying Proportion of *F. thonningii* fresh leaves.

	Groups				
Feed intake	**A**	**B**	**C**	**D**	**SE**
F.thonningii					
DM	-	205^{c}	407^{b}	511^{a}	52.0
%intake	-	23.1	42.3	53.1	-
Intake as % live weight	-	0.75	1.50	1.82	-
D.smutsii					
DM	622^{a}	445^{b}	252^{c}	208^{d}	43.0
Intake as % live weight	2.25	1.63	0.89	0.75	-
Total forage (DM) intake	622^{d}	655^{c}	659^{b}	719^{a}	8.0
Concentrate intake	269	275	268	279	-
Total Feed intake	891^{c}	925^{b}	927^{b}	996^{a}	8.0
Total feed intake as % live weight	3.24	3.38	3.39	3.59	-
Live weight change					
Initial weight	26.4	25.4	26.0	26.6	-
Final weight	28.8	29.1	28.9	29.0	-
Live weight Gain	2.4	3.7	2.9	2.4	-
Averge daily gain (ADG)(g)	48.0	68.0	57.0	46.0	0.68

a,b,c,d Means in a row with the same superscript letter are not significantly different (p>0.05).

4.3.2 Frequency of Oestrus (FO) and Oestrus Cycle Length

Data on frequency of oestrus (FO) and oestrous cycle length (OCL) are summarised in Table 7 and 8. Results showed that treatment effect was not significant (>0.05). Frequency of oestrus was highest for animals in group C, with value of 93.3% while animals in groups D and A had 82.5% each and group C had 85.0%. The overall mean for FO was 85.5%. There was therefore, no observed trend in FO as a result of varying proportion of *F. thonnigii* in the basal diet.

Table 7: Frequency of Oestrus of Yankasa Sheep Fed Diets Containing Varying Proportion of *F. Thonningii*

Groups	No. of Ewes Expected	Total No. Observed	FO %
A	40	33	82.5
B	40	34	85.0
C	32	30	93.3
D	40	33	82.5
TOTAL	152	130	85.5

Table 8: Least Square Means of Oestrous Cycle Length of *Yankasa* Ewes Fed Diets Containing Varying Proportion *Ficus thonningii.*

Groups	No. of Observations	OCL (days +SEM)
A	21	17.5±0.3
B	21	16.7±0.3
C	20	17.0±0.3
D	22	17.5±0.3
Overall	84	17.2 + 0.2

4.3.2 Conception and lambing rates (CR and LR)

Table 9 presents the reproductive performance of the experimental ewes. No significant effect was observed (P>0.05). Percent conception rate for all experimental animals were 90, 100, 100 and 70 for groups A, B, C and D respectively. The highest lambing rate (88.9%) was recorded for the control group (A) this was followed by groups C, B and D with values of 87.5, 80.0 and 71.4% respectively. Total number of lambs born was 30 with animals in groups A and B having 9 lambs each while groups C and D having 7 and 5 respectively. Litter size of 1.2 was recorded for groups A and B and 1.0 for groups C and D. Group D had least reproductive performance, even though treatment effect was not statistically significant.

Table 9 Reproductive Performance of *Yankasa* Ewes Fed Different Levels of *F. thonningii* leaves

Items	Groups				
	A	B	C	D	Overall
No. of Ewes	10	10	8	10	38
Ewes Bred	9	10	8	7	341
Conception Rate (%)	90	100	100	70	89.5
Ewes Lambing	8	8	7	5	28
Lambing Rate (%)	88.9	80.0	87.5	71.4	82.4
Lambs Born	9	9	7	5	30
Litter Size	1.2	1.2	1.0	1.0	1.1
Lambs/Ewe	1	1	0.88	0.71	0.88

4.4 Serum progesterone Profile of ewes:

Result of serum progesterone assays in the experiment is presented in Table 10. There was no significant difference between treatments (P>0.05). Although animals in group B and had the highest means of 1.44±0.145 ng/m/ while the least mean was observe in the control group (1.310±0.145 ng /m/).

Normal cyclic pattern (Fig 1 to 4) in all the ewes was observed from the serum progesterone profile and it agreed with observed behavioural oestrus., Mean of serum progesterone level at the time of oestrus was 0.15±0.1ng/ml while progesterone at mid-cycle (days 10-14) was 4.18±0.09ng/mg.

Table 10 Least - Squares means of Serum Progesterone Levels of ewe fed different Levels of *F. thonningii* Leaves

Treatment	No. of Observed Samples	Serum Progesterone (P4) Levels (ng/ml) (±SEM)
A	75	1.31±0.145
B	75	1.44±0.145
C	75	1.34±0.145
D	75	1.38±0.145
Overall	300	1.34±0.184

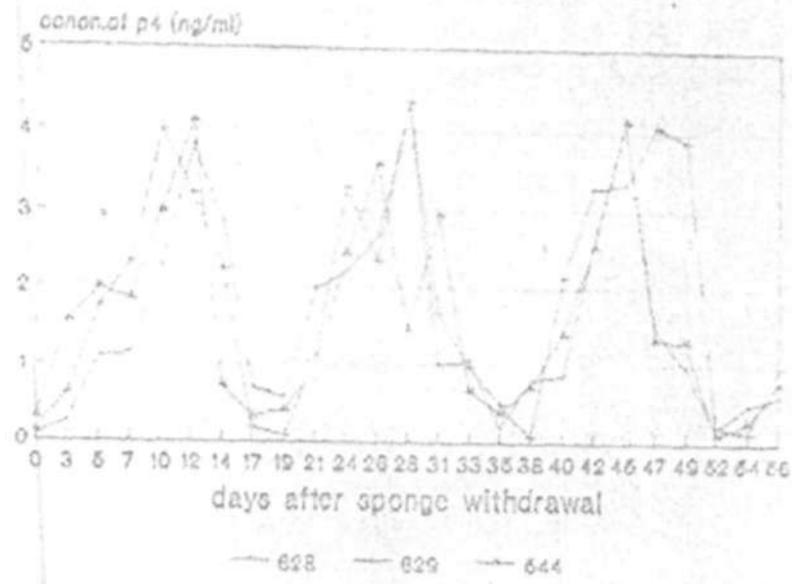

Fig. 1 Serum progesterone profile of Yankasa ewes fed with 0% of *F.thonningii* leaves

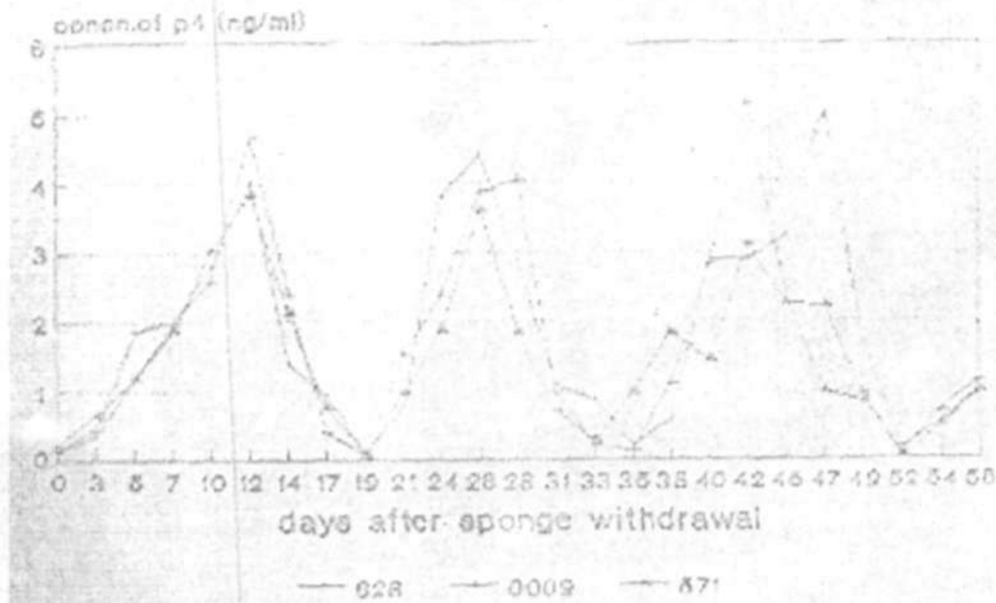

Fig. 2 Serum progesterone profile of Yankasa ewes fed with 25% of *F.thonningii* leaves

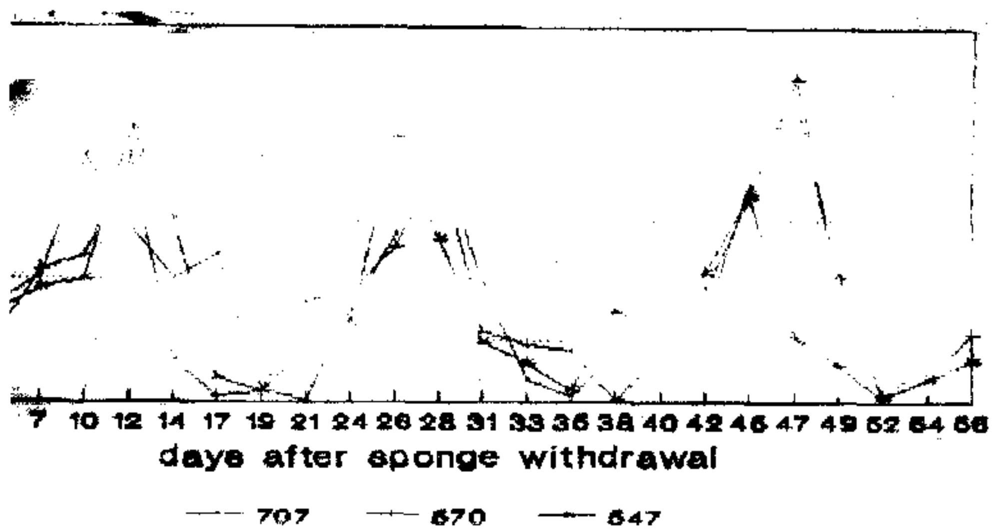

Fig. 3 Serum progesterone profile of Yankasa ewes fed with 50% of *F. thonningii* leaves

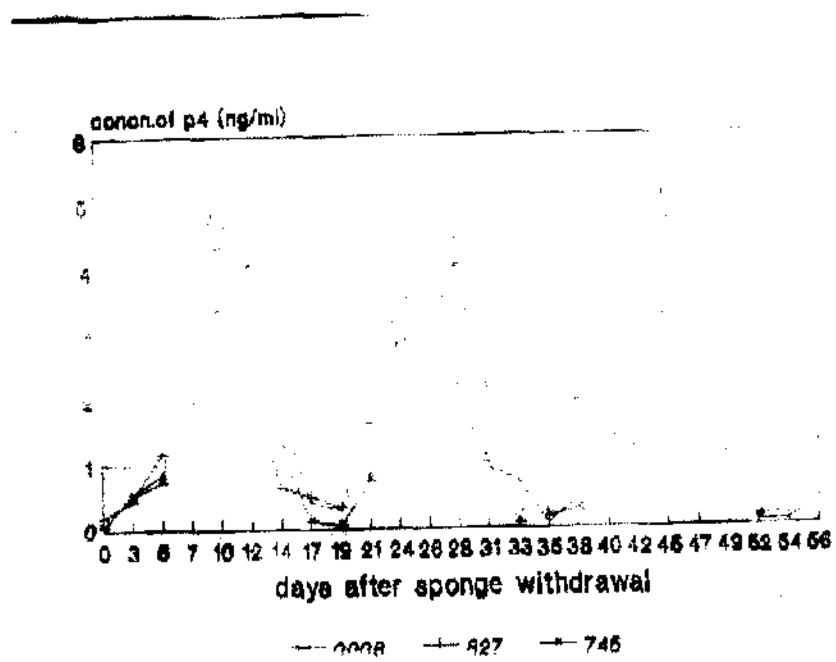

Fig. 4 Serum progesterone profile of Yankasa ewes fed with 75% of *F. thonningii* leaves

CHAPTER FIVE

5. DISCUSSION

5.1 Identification of Ficus Species

The 8 *Ficus spp.* Identified are among 39 species reported to be found in Nigeria (Hutchinson and Dalziel, 1958). They are also among the 15 identified at A.B.U, Zaria by the Biological Sciences Department herbarium. *Ficus Capenis, F. gnaphalocarpa, F. ingens* dnd F. thonningii were also reported to be found in East and South Africa (Watt and Breyer-Brendwijk, 1962). Dalziel (1938) reported them to be common shade trees of most city centres in different parts of tropical Africa. *Ficus polita* and *F. thonningii* especially the latter are the most common *Ficus* species grown in compounds of most Hausa communities. In these communities, mystic and medicinal values are attributed to *F. thonningii* apart from its use as feed for livestock. This may be the reason for its abundance.

5.2 Proximate and Mineral Composition

The DM content of *Ficus* species leaves obtained in this study is in agreement with the mean 33.6% for 21 browse trees analyses Adegbola (1989) and 33.1±0.60% for Southern Nigeria browse Species (Mecha and Adegbola, 1980). The CP values were lower than 14.9 and 14.5% reported for F. elasticoids and F, exaperata from Southern Nigeria (Mecha and Adegbola, 1980; Adegbola, 1985). Agishi (1989) also reported CP for *F. phatyphylla* to be 14.38%. However, CP of 8.9% for *F. gnaphallocarpa* (Rose-Innes. 1964) was similar to that was obtained in this study for the same species. These species were found to have low NDF content, lower than the 55 to 60% which as reported by Van Soest, (1964) . The EE was lower then 10.0% for *F. elasticoid* (Adegbola, 1980) but slightly higher than 2.78% (Mecha and Adegbola, 1980) for West Africa browse trees. In terms of minerals the species were rich in calcium but low in phosphorus and Magnesium like most of the West Africa tree specie (Le Houeroe, 1980b). The calcium to phosphorous ratio was about 9:1 which much higher than 2:1 recommended for ruminant animals (Ranjhan, 1980).

Comparing these specie with those found in Asia, similarities were observed in % DM, EE, Ash and CF contents. But a wide variation exists in the crude protein content (Appendix 2). Variation within and among species could be due to the locally in which the plant is growing, season, age of plant, part of the plant and the type of soil the plant growing on (Majumdar et. al, 1967).

The mean nutritive composition of these species can be said to be similar to that of fresh grass (DM 34.2%, CP 14.9%, CF28.8, EE 2.3%, Ah 5.6% and NFE 46.0%) (Adegbola, 1985; Rajhava, 1990). From this, it seems that the *Ficus* species may meet the nutrient requirement of ruminant livestock.

5.3 Performance of Yankasa ewes fed different Levels of F. thonningii fresh leaves

Mean daily DM intake for the animals in this experiment was found to range from

3.24 to 3.59% of live weight. This is lower than 3.8% of live weight for sheep (Sarson and Salmon, 1978; cited by Atta-Kran, 1990). But higher than 2.8% of body weight (Akinsoyinu, 1985; Adu and Lakpini, 1983).

Data on voluntary intake of browse by livestock is scanty. In their study in which goats were fed *F. tsiela* supplemented with wheat bran, Bhaid and Methane, (1987) found daily intake of the browse leaves to range from 3.69 to 4.53% of live weight which is higher than what was obtained in this work, this difference could be due to the difference in grass capacity (gut space available for roughage intake) of these species of animals. Grass capacity for goats ranged from 25 - 40% live weight while that for sheep is from 12.5 - 25% live weight (Mackenzie, 1980). This study found the highest intake of browse to be 61.5% of the total fodder diets Carew et al. 1980 however, showed that WAD sheep and goats stall fed with six browse plants and *Panicum maximum* consumed 90 - 94% as browse. The actual consumption of browse (Adegbola, 1985) depends on quality of the browse, availability, species of browse and animal, season and ecological zone.

Increasing the levels of *F. thonningii* leaves in the diet was found to increase intake of *D. smutsii* hay, and increase in total DM intake, reflecting amount offered, the same was observed (Reynolds and Adediran, 1988) when WAD sheep were fed basal diet of *P. maximum* grass with cassava peels supplemented with *Leucaena* and *Gliricidia* fresh leaves. This result is in further agreement with other finding, that browses improve the intake of poor quality roughage (Atta-Khra, 1990).

Animals offered the least browse gained the highest weight in this study. This is contrary to what was reported by Reynolds and Adediran (1988) and Ademosun et al, (1988). This difference could be due to the type of browse used. The above author used leguminous browse species (*Leucaena* and *Gliricidia*) in their study which differed in chemical composition from *F. thohningii*. However, Devendra (1990) suggested dietary levels of inclusion of browse to be 30-50% (0.9 to 1.5% live weight) for practical and beneficial application in feeding systems of ruminant livestock. This is reflected in this study as animals that were given (0.75 - 1; 5% live weight) browse benefited better.

Also reproductive performance was better for animals that were in groups B and C than for the other groups. Mean oestrus cycle lengths (OCL), frequency of oestrus (FO) were normal. Mean oestrous cycle length OCL (17.2±0.2 days) is similar to 17 days (Terril, 1974) in sheep, while for *Yankasa* breed mean OCL of 16.8 days and 18.1 days were reported by Kuteyi (1978); Igono et al. (1982); Oyedipe et al. (1986); Adu and Osinowo (1986).

Mean litter size (1.1) is slightly lower than reported value of 1.2 (Osinowo and Abubakar, 1989). This low value in LS could be due to the age of the animals as 2-3year old animals used in the experiment. Conception rates were normal in all the 4 groups.

Protein intake was highest in group D as such, it was expected that performance of the animals in that group would be better than the other animals. However, this was not reflected in the results as animals in this group gained the least weight (46.0±0.68 g/d) and had the least CR, LR, and LS (70.0%, 71.4% and 1 respectively). This indicates that certain toxic factor(s) may be responsible for this low performance. No toxic symptoms were however observed throughout the experimental period. However it was not possible to carry out enzyme assay and study the blood profile of these animals due to lack of facilities necessary for such studies.

5.4 Serum: progesterone profile of ewes

Studies on progesterone profile of sheep fed any browse species were not found. The mean peak value of (4.175±0.9ng/ml) is slightly higher than reported value of 4ng/ml (Robertson, 1977; Pant et al., 1977). Mean serum P4 levels of 1.34±0.18ng/ml is close to 1.39±0.19ng/ml (Oladimeji, 1994) while P4 level at oestrous (0.15±0.80 ng/ml) is slightly higher than 0.12 ng/ml (Oyadipe, 1986) in the same breed of sheep.

The progesterone profile observed in this study was not different from that available in literature for other breeds of sheep (Robertson, 1977; Pant et al., Oyediji, 1994). Also pattern of oestrus is also similar to the pattern previously reported for Yankasa breed (Olademiji, 1994; Oyedipe, 1986). The trend was lower concentration during oestrous periods and a peak during mid and late cycle (days 10 - 14)

CHAPTER SIX

6. CONCLUSION AND RECOMMENDATION

Eight *Ficus* species were identified in the premises of the National Production Research Institute where the current study was carried out. They were analyzed chemically and one of them *F. thonningii* was later fed with *Digitaria smutsii* hay at various levels in the total diet. The proximate analysed of the identified species showed them to be moderate in crude protein (9.6±0.6%) and acid detergents fibre (33.1±1.7%) and low in lignin suggesting that these browse species could be used to advantage as supplement to low quality pasture which are the main feed available to ruminant during dry seasons.

Total feed intake increased as the proportion of *F. thonningii* leaves and consequently CP in the total diet increased suggesting improved intake in response to increase dietary protein. This is evidence that dietary protein concentration affect the voluntary intake of grasses with low CP content. The study therefore, indicates that *F. thonningii* with its moderate CP content could be utilized in roughage diets to improve roughage intake which is one of the most important factors determining animals' productivity. Furthermore, as a browse *F. thonningii* is available during dry season when low intake of poor quality grasses cause reduction in live weight of animals and its use could result in partly arresting the losses in live weight of animals during the dry season. However, the present study appears to indicate that dietary level of *Ficus thonnigii* in exces of 50% may further increase total roughage intake, but the advantage was not reflected in weight gains. This could probably be due to some inherent toxic factors which were not detected in this study.

Reproductive performance interms of oestrous cycle length, frequency of oestrus, litter size, conception and lambing rates of the animals fed diets containing varying proportions of *F. thonnigii* leaves were normal and did not differ statistically, however least values for the above mentioned parameters was found found with animals fed diet containing the highest amount of the browse leaves suggesting that *F. thonnigii* in excess of 50% in the diet is likely to have adverse effects on the reproductive performance of sheep. Treatment effect were not significant for serum progesterone levels and normal cyclic oestrous pattern were observed from the serum progesterone profile which corresponds to observed behavioural patterns.

It would appear therefore that dietary levels of *F thonnigii* in excess of 50% may be detrimental to growth, and certain aspect of reproductive performance of *Yankasa* sheep. Unfortunately, study on toxicity of *F. thonnigii* was not carried out due to unavailability of necessary facility. Such study might provide information that could give clues to why the level of inclusion of *F. thonnigii in excess of* 50% depresses growth and reproductive performance. It seems that claims by local herdsmen that certain species of *Ficus* are harmful to livestock may be substantial. It is therefore important for more studies to be carried out on *Ficus* species in order to determine the detrimental factor(s) and it /their effects of on livestock for the species to be fully recommended as an important dry season feed.

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APPENDIX 1

Ficus spp. found in Nigeria

Species	Places found
Ficus abutiofolia	Nupe, Katagum
Ficus amomani	Benin
Ficus asperifolia	Nupe, R. Niger, Koton Karfe, Aboh
Ficus barterii	Onitsha, Anambra
Ficus capreifolia	Nupe, Zaria, Katagum
Ficus capensis	Katagum, Lagos
Ficus congensis	Gimi, Zaria, Old Oyo
Ficus conrani	Lagos, Agege
Ficus dekdekena	Zaria,
Ficus elasteoid	Ijebu-Ode
Ficus elegan	Lagos
Ficus eriobotyoides	Ankpa
Ficus exasperate	Ebuta metta, Abeokuta
Ficus gnaphalocarpa	Zurmi
Ficus glumosa	Dekina, Birnin Gwari, Zaria, Sokoto, Katagum, Nupe, Yola, Nsukka
Ficus goliath	Olokomeji
Ficus ingens	Zaria, Lagos, Oyo
Ficus itteophylla	Sokoto, Katagum, Geidam
Ficus iyrata	Southern Nigeria
Ficus kamera	Cross Rivers
Ficus kimuenzensis	Calabar
Ficus lecardii	Zaria, Yola
Ficus leprieuri	Lagos
Ficus mucosa	Oyo
Ficus natalensis	Kaduna, Kogi
Ficus ottoriifolia	Ebuta metta, Ibadan
Ficus ovata	Dekina, Birnin Gwari, Zaria
Ficus platyphylla	Zurmi, Bauchi, Borno
Ficus poulifolia	Okene, Kilba
Ficus polita	Kaduna, Katagum, Owerri
Ficus praticola	Benin
Ficus pseudomangifera	Sapoba
Ficus sagittifolia	Olokemeji
Ficus thonningii	Sokoto, Zurmi, Kukawa, Lagos
Ficus umbellate	Bida, Ibadan
Ficus vallis-chodae	Bida, Sokoto, Bauchi, Lagos, Oyo
Ficus variifolia	Kaduna, Oyo
Ficus vogeli	Niger, Lagos, Calabar
Ficus vogeilana	Lagos

Source: Huchinson and Dalziel 1958

APPENDIX 2

CHEMICAL COPOSITION OF SOME *FICUS* SPECIES USE AS LIVESTOCK FODDER

SPECIES	DM %	CP %	CF %	EE %	NFE %	Ash %	Ca	P	Mg	Reference
[1]*F. bengalensis*	-	9.6	26.8	2.64	51.59	9.30	-	-	-	Hussain-Mia (1960)
[2]*F. clavata*	32.20	18.0	20.5	3.30	40.60	17.6	-	-	-	Joshid and Signh (1990)
[1]*F. cunia*	-	15.2	23.9	1.08	50.20	9.68	-	-	-	Varma et.al. (1982)
[3]*F. fistosa*	19.6	14.0	15.1	1.90	-	11.7	2.47	0.24	-	Wong (1990)
[4]*F .elasticoid .*	-	14.9	21.5	4.70	46.41	12.5	-	-	-	Mecha and Adegbola (1980)
[4]*F. exasperata*	-	14.5	25.0	10.0	38.55	12.0	-	-	-	Adegbola (1985)
[1]*F. glomerata*	-	15.2	15.0	2.87	-	18.4	2.96	0.45	-	Majumdar et.al. (1967)
[5]*F. gnaphalocarpa*	-	8.9	14.9	-	-	16.0	2.60	0.14		Rose-Innes (1967)
[2]*F. hispida*	31.7	24.2	23.9	4.10	35.30	12.4	-	-	-	Joshid and Signh (1990)
[1]*F .lacor*	42.0	13.0	21.3	2.8	51.8	11.2	-	-	-	Joshid and Signh (1990)
[2]*F. nemaralis*	30.0	13.4	19.0	4.30	51.10	12.2	-	-	-	Joshid and Signh (1990)
[1]*F. neriifolia*	-	17.9	16.4	1.23	60.64	3.71	-	-	-	Varma et.al. (1982)
[1]*F. nervosa*	-	25.9	26.7	2.00	27.82	17.5	-	-	-	Varma et.al. (1982)
[4]*F. platyphylla*	-	-	-	-	-	-	1.14	0.13	0.70	Agishi (1985).
[1]*F. religiosa*	-	20.5	22.6	5.38	37.83	13.7	-	-	-	Varma et.al. (1982)
[1]*F: roxbergi*	-	13.4	7.71	4.65	68.87	-	1.31	0.17	-	Rhagavan (1990)
[1]*F. roxburghii*	37.0	18.3	36.8	4.50	39.70	11.3	-	-	-	Joshid and Signh (1990)
[1]*F. semicordata*	44.0	14.0	-	2.80	40.20	31.3	-	-	-	Joshid and Signh (1990)
[4]*F. thoningii*	-	-	-	-	-	-	1.05	0.15	0.34	Agishi (1985)

Superscript number indicates the country in which the study was carried out
1=India 2=Nepal 3=Malaysia 4=Nigeria 5=Ghana