EFFECTS OF FEEDING VARYING LEVELS OF SUN-DRIED CASSAVA PEELS AS SUPPLEMENT ON REPRODUCTION OF WEST AFRICAN DWARF EWES

BY

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A DISSERTATION DEFENCE PRESENTED TO THE FACULTY OF AGRICULTURE, DELTA STATE UNIVERSITY, ASABA CAMPUS, ASABA, IN PARTIAL FULFILLMENT FOR THE AWARD OF M.Sc. (ANIMAL SCIENCE)

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DECLARATION

I declare that this is an original research work carried out by me Mbagwu Alpheus Eze, in the Department of Animal Science, Faculty of Agriculture, Delta State University, Asaba Campus, Delta State.

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Mbagwu Alpheus Eze **Date**

CERTIFICATION

This is to certify that this project work was carried out by Mbagwu Alpheus Eze in the Department of Animal Science, Faculty of Agriculture, Delta State University, Asaba Campus

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DEDICATION

This project is dedicated to God Almighty, God, also to my loving and caring wife and my children

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ABSTRACT

The experiments conducted in this study were aimed at finding the effects of feeding varying levels of sundried cassava peels as supplement on the reproductive activities of West Africa Dwarf (WAD) sheep. Twenty four cycling nulliparous West African Dwarf ewes aged 12-15 months and weighing 9-12kg were used for this study. The animals were randomly allotted to four groups (i-iv) of six animals per group to receive 0, 2, 4 and 6% average body weight of supplementary sundried cassava peels, respectively. Each group had 3 replicates of 2 animals each. During each feeding time, the animals were offered supplement first and allowed to finish it before they were subsequently allowed to graze with access to water *adlibitum*. The proximate analysis of the sundried

cassava peels was undertaken. The effects of the supplement on the duration of estrous, length of estrous cycle and pregnancy and post partum resumption of ovarian activities were determined. Weight gain, cassava peel feed intake, efficiency of cassava peel utilization were also monitored. Results obtained showed that the mean final body weight of those nulliparous ewes that received 6% supplement was significantly ($P<0.05$) higher than those that received 0, 2, and 4%. There was no significant ($P>0.05$) difference in the mean final body weight of the ewes that received various supplement levels during pregnancy and post partum period. The mean cassava peel intake of those animals that received 6% feed supplement was significantly ($P<0.05$) higher than those that received 0, 2, and 4% supplement. The efficiency of cassava peel utilization decreased linearly with increasing dietary levels. Mean estrus duration, estrous cycle length and post partum estrous length of those animals that received 6% supplement were higher than those that received 0, 2, 4% levels. The mean weight of lambs at birth for the ewes that received 6% feed supplement was significantly higher ($P<0.05$) than those that received 0, 2 and 4%. The shortest pregnancy duration was observed in those animals that received 6% supplement. All the animals had single birth, no mortality or abortion was recorded throughout the duration of the study. Supplementation of grazing West African Dwarf sheep with sun-dried cassava peels at 6% average body weight of supplement significantly increased the body weight of sheep before conception, during pregnancy and postpartum as well as improved reproductive parameters.

CHAPTER ONE

1.0 INTRODUCTION

Livestock contribute significantly to food and nutrient supply particularly high quality protein, minerals, vitamins and micro-nutrients for the majority of African people. Meat, milk and egg provide about one fifth of the protein in African diets (All African Society of Animal Production, 2010). According to All African Society of Animal Production (2010), in 2003, Africa's livestock population was estimated at 231 million cattle, 244 million sheep, 273 million goats and 22 million pigs. Livestock contribute about 30 percent to the agricultural GDP in Africa.

Ruminant livestock are numerous in Nigeria but their production is based on age-old husbandry systems, which need to be gradually modified in order to meet the needs of consumers. Cattle, goats and sheep production systems are traditionally managed to about 85% for all species (Tewe and Bokanga, 2001). Livestock play an important role in Nigerian agriculture, contributing about 12.7% of the total agricultural GDP (CBN, 1999). Nigeria is one of the four

leading livestock producers in Sub-Sahara African, according to RIM (1990). The livestock population in Nigeria comprised about 13.9 million cattle, 34.5 million goats and 22 million sheep (lawal-Adebowale, 2012).

Sheep play an important role in the economic life of the people of Nigeria making significant contribution to the national economy.

There are four major types of sheep native to Nigeria; they are Balami, Uda, Yankasa and West African Dwarf (WAD). Balami and Uda are reared mainly in the semi-arid regions, West African Dwarf sheep in the South and Yankasa throughout the country (Bourn *et al.,* 1994).

In developing countries, sheep produce about 48% of the world mutton and lamb, 58% of the world's sheep milk and 47% of the total world sheep hide and skin (FAO, 1988). Based on available figures it can be said that half of the total world sheep is produced in the developing countries. These figures demonstrate that potentials exist in the country to provide animal protein needs of the populace. It is recognized that in order to achieve these potentials, the quantity and quality of feed supplied to livestock must be adequate. However, in most countries of Africa including Nigeria, feed supply is a problem as it is inadequate and of poor quality (Otaru, 1998).

Small ruminants are second to cattle in terms of meat supplies in Nigeria (David – West, 1985). They are able to thrive and survive in a wide range of ecological conditions. These make them more suited to utilizing locally available feed resources for meat and milk production. A study of the village

production systems in Nigeria shows that the two major problems affecting small ruminant production are inadequate nutrition and health (Otchere *et al.,* 1987, Ademosun *et al.,* 1988, Ademosun, 1994). Significant improvement can be achieved in livestock production with improved nutrition using local resources. In 1986, Nigeria produced 14.7 million tones of cassava (FAO, 1986), while the demand for this crop was put at 25 million tones for 1988. It is therefore safe to suggest that feeding cassava meal to livestock is not likely to be an attractive economic proposition (Adegbola *et al.,* 1988).

Cassava peel however has been shown to form a constant part of household waste product traditionally offered to sheep and goats in Southern Nigeria (Obioha, 1977). There are a large number of village-level, small-scale and large-scale "Garri" processing factories which generated an estimated 2.9 million tones of cassava peels in Nigeria in 1986 (Adegbola *at al.,* 1988). Considerable research effort is being put into processing cassava peel for use by small ruminants at village level (Obioha, 1977; Adegbola and Asaolu, 1986). The large amount of cassava by-product obtained in the "garri" and starch processing factories will only be useful if the peel is incorporated into livestock diet formulation. If the waste products are processed into livestock diets and properly packaged, they will become available and readily find a market with household owners and small ruminant stock as well as urban livestock owners.

Although potentials of cassava and its by-products have been studied as source of ruminant feed, little or no information is available on its effects on the reproductive performances of ruminants in Nigeria.

1.1 Statement of Problem

There is need for increased animal production in Nigeria because the population of Nigeria is constantly on the increase. Many Nigerians consume less than 10g of animal protein daily, against the minimum 35g/head/day for a balanced diet. If we are to have remarkable success in increasing the availability of animal protein in Nigeria, deliberate effort must be made to better the management systems, the environment and plane of nutrition and disease control. Animals with high reproductive efficiency have been recognized. This will depend on the length of pregnancy, litter size, normal viability, and growth of new born during breastfeeding and at puberty.

1.2 The Objectives of the Project

The broad objective of this study is to determine the effect of sun-dried cassava peels on reproduction in the West African Dwarf (WAD) sheep

1.3 Specific Objectives

The specific objectives are to determine the effects of sun-dried cassava peels on:

1. Weight at various stages of reproduction.
2. The duration of estrus and length of estrous cycle.
3. Gestation length and postpartum resumption of ovarian activities.

1.4 Research Justification

Nigeria should discover practical and economical ways of enhancing reproduction in livestock especially sheep.

Nigeria has numerous village, small scale and large factories that process garri. These factories generate million tones of peels which are regarded as waste products. These waste products could be a cheap supplement to grazing done by the local farmers

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Potentials of small ruminants

All African Society of Animal Production (2010) reported that Africa has 244 million sheep and 223 million goats. The ownership pattern of small ruminants in Africa compared to cattle, shows that they are more popular among small-holder farmers (Otaru, 1998). In Nigeria for example, goats are kept at the rate of 5.7 per compound and sheep at 3.7 (FLDPCS and RIM, 1992). Small ruminants are regarded as cow for the poor man. This is because they have the ability to provide meat, milk and skin for the owner's need and may have little extra for sale. Based on this statement, one would not wonder why ruminants always fall into the hands of poor farmers who purchase them only to allow them to roam about in the village in search of feed. This is so because the initial capital required for procurement and maintenance is low. According to David-West (1985) small ruminants contribute the second most important source of

meat after cattle in Nigeria. They can survive like cattle on feed resources other than cereal grain or concentrate feeds. They thrive more than cattle in wide ecological zones of the country; have lower feed requirements and being kept mostly by poor farmers if more priority is given to them, it is believed that more meat will be produced in the country (David-West, 1985). Olaloku (1987), however contrasted this statement with more recommendation that priority should be given to pigs and poultry to attain accelerated increase in animal protein production n West Africa.

The tropical sheep breeds are predominantly reared for meat and rarely are they milked for human consumption. Their skins are also excellent materials in the leather industry, for making valuable products such as shoes, bags, and belt and even wear. Over two decades ago the complimentary role of sheep milk to dairy production was also realized. Sheep are also being kept for milk and fiber production in the tropics, provides manure, ready cash if crop fails, research animals, recreation, transportation, slaughter animals at festivals and prestige. One would then expect that research into many ways of improvement in both production and economic traits to have been perfected. On the contrary, this is not so because concerted effort has not been made to actually assess the potentials of the indigenous sheep breed for reproduction. In view of the large population of sheep in Nigeria most especially Yankasa breed, the complementary role of sheep to rural dairy production in Nigeria should not be over-looked (Ehoche *et al.,* 1990).

Sheep are well integrated into the crop-livestock farming system where crops and livestock complement each other and reduce the risk farmers could face by focusing exclusively on crop or animal agriculture. Crop livestock integration presents opportunities for nutrient cycling enhanced income per unit of land and sustainable agriculture (Winrock International, 1992). According to Osei (2012) some of the benefits derived from crop – livestock integration include the manure derived from livestock that improves soil fertility and contributes towards sustainable agriculture under smallholder conditions. Small ruminants in turn convert crop residues generated from cereals and legumes into valuable and high quality food in the form of meat and milk for humans (Oltjen and Beckett, 1996, Ibrahim, 1998). Sheep always generate income and food for the direct benefit of resource – poor people. Farmer in the subsistence sector of the agriculture rely on sheep for much of their livelihood than cattle. They are a typical feature of smallholder farms and generally owned by the poorer strata of society. Any intervention that improves the productivity of sheep is an important route to creating wealth and improving the standard of living of the resource – poor farmer (Salifu, 2014). At the beginning of the raining season small ruminants are offered for sale and the income generated from the sales are used to purchase fertilizer, seed, labour and other farm inputs. Farmers can quickly establish a flock of sheep as a major capital asset because of quick production turnover of sheep (Salifu, 2014)

Like goats, sheep represent an important “emergency” capital asset that can be sold for house hold needs, school fees, medical bills and other emergencies (Annor, 2002). The social function of small ruminants may be as important as food and cash, although it is difficult to place monetary value on the personal satisfaction and social prestige derived from sheep rearing by their owners (Adogla Bessa *et al.,* 2005).

This is why ownership of sheep in the developing world confers a social status. Ibrahim (1998) stated that small ruminant meat contributes on the average 18% of all meat consumed in Sub-Sahara Africa; their production therefore plays an essential role towards achieving food security. Winrock International (1992), Ibrahim (1998), had it that consumption of even small amounts of their meat helps in ameliorating amino acid deficiencies in areas where diets are primarily cereal and legume – based ones. They are often sacrificed for religious and cultural purposes and presented as gifts and dowries in some cultures.

2.2 West African Dwarf (WAD) Sheep

In Nigeria, the breed is variously called Southern Forest Sheep (Orji *et al.,* 1972) or Nigerian Dwarf Sheep (Adu, 1972). They are found throughout the humid zone of West Africa (Payne, 1990) through the hot and humid coast areas South of latitude 140N (Adu, 1972). Within this wide geographical range, variation in type is found. Their colour is generally black piebald on white, tan

piebald on white predominantly. The West African Dwarf sheep is small with a compact body and hardy. Mature weights are 20-25 kg for ewes and 25-30 kg for rams. WAD sheep are primarily reared for its meat (Sowande, 2007, Taiwo *et al.,* 1983). They are highly adaptable to a broad range of environments. They can utilize a wide variety of plant specie and are thus complementary to cattle and camels. They generally do not compete directly with these species for feed. They can utilize fodder resources high in crude fiber and present the advantage of high productive performance and a small body size that makes it feasible to adapt to extreme environment conditions (Peters, 1988). The adult male has a well developed throat ruff and is horned. The females are usually polled. They can be bred at the age of 7 to 8 months. They tend to have a short lambing interval. The prolificacy of adult ewe is low to moderate ranging from 1.15 to 1.50 lambs per lambing. Their growth rate is low and lamb mortality is high. This breed is trypanotolerant in nature (Taiwo *et al.,* 1983).

2.3 Prospects of sheep production

Sheep produce food and fibre at relatively low cost from food materials and on land that often cannot be used in any other way. Their high and increasing efficiency is due not only to their ability to use low quality feed stuffs and sparse natural forage but also their early puberty, short gestation period, rapid growth rate and good marketability. Sheep do not compete with people, pigs or poultry for good food because they can survive on forage alone

and require little grain or concentrates for good production. Small ruminants produce about twice as much meat per animal unit in the tropics as cattle (Terill, 1983). Sheep compete with other livestock in quality of meat produced. Meat from sheep is generally tenderer than grass-fed beef. The animals can be marketed at a much younger age. Lamb meat is more established in marketing systems than in goat meat, but both are quite delicious, especially under one year of age. Sheep can supply efficiently and has low cost of production (Terril, 1983).

2.4 Overview of the physiology of reproduction in sheep

Reproduction in farm animals involves complex interlinked biological processes with characteristic patterns. The main process of reproduction in female farm animals is the initiation of cyclical ovarian activity in the female which results in estrus behaviour and the release of a healthy ovum during ovulation. When the animals are mated, it results to fertilization, pregnancy and implantation of embryo in the uterus which has been functionally and structurally made competent by hormones (Vetheraniam *et al.,* 2010). The emerging embryo(s) and foetus(es) are nurtured in the suitable environment from pregnancy to parturition (Gatenby, 2002; Vetheraniam *et al.,* 2010).

Reproductive processes are helped along by numerous hormones and involve multiple metabolic and hormonal pathways (Hess *et al.,* 2005; Garnsworth *et al.,* 2008). Reproductive events in sheep, as in other non –

primate animals, revolve around the estrous cycle, which provides multiple opportunities for an animal to become pregnant (Senger, 2003).

2.4.1 Estrus and estrus duration

Estrus is commonly called standing heat and the best confirmation of estrus is when the ewe stands when being mounted (Girma, 2005). It is the phase of the estrous cycle when the ewe will be receptive to the ram (Dzulkarnain, 2015). Estrus duration ranges from 24-36hrs (Dzulkarnain, 2015, Delma, 2015, Paul, 2015). Most ewes exhibit estrus for 24-36hrs while many exhibit for either less or more time (Delma, 2015). The duration of estrus is variable in that it is shorter in young ewes but longer in older animals and it is influenced by the breed, age, onset of puberty and presence of ram and season. The average estrus duration of 33hrs for West African Dwarf ewe has been reported by Ngere *at al.,* (1979), Adu, (1972), Dettmers *et al.,* (1976). Sheep and goats are seasonally polyestrous and short-day breeders, meaning they will cycle regularly with the shortening days of fall (Schatten and Constantinescu, 2007).

Aboulgasem *et al.,* (2015) researched on fertility of Libyan Barbary sheep treated with prostaglandinf2∝ (PGF 2∝) in different seasons and reported that variation in estrus duration or discrepancies in their results could be attributed to the difference in the breed variations, nutrition, seasonality effect, climatic and environment factors.

2.4.2 Estrous Cycles of Sheep

Estrous cycle is a sequence of physiological events with species-specific duration that involves morphological changes in the reproductive system and behavioural changes in the animal (Pineda, 2003). The cycle repeats itself in healthy non-pregnant animal at a defined interval. Estrous cycle occurs several times during the year in the tropics in domestic sheep (non-seasonal breeders) but occur in the seasonal breeders during the breeding season.

The average length of the estrous cycle in sheep has been reported variously. Pineda (2003) reported 16 or 17 days. Ngere *et al.,* (1979), Adu (1972) Dettmers *et al.,* (1976) reported 18.5 days for WAD sheep. Estrous cycle in sheep can be short, normal and long depending on factors such as nutrition, diseases (Garci *et al.,* 1989, Ijabo *et al.,* 2014). The incidence of the long and short luteal cycles among Yankasa in Nigeria had been reported by Oyedipe *et al.,* (1986) and could be among the major problems responsible for reductions in herd fertility and reproductive management in Africa (Rekwot *et al.,* 2000). Emady *et al.,* (2006) reported 3 types of estrous cycles in 69 Abade does. He summarized the distribution of inter-estrous intervals categorized as “short” (<17 days), “normal” (17-23 days) and “long” cycles (> 23 days).

Kawu *et al.,* (2007) also observed 12 days short estrous cycle in Red Sokoto goat.

Hafez and Hafez (2000) reported 16-17 days. The estrous cycle is dated from the first day of estrus. The ovarian cycle of sheep has two recognized

phases namely the follicular phase associated with growth of follicles and the luteal phase associated with the corpus luteum formation and secretion of progesterone.

Estrous cycle operates under the control of the hypothalamo-pituitary ovarian axis (Noakes *et al.,* 2001). The important hormones involved in the regulation of estrous cycle are gonadotropin releasing hormone (GnRH) originating from hypothalamus, follicle stimulating hormone (FSH) and luteinizing hormone (LH) from the anterior pituitary gland and the ovarian sex steroids, oestradiol and progesterone. The FSH is responsible for the development of ovarian follicles from the time they have become antral and have reached a size of 2.3mm. Oestradiol is secreted by the theca cells when follicle is stimulated by FSH. The action of FSH is curtailed by oestradiol and inhibin through a negative feedback mechanism (Hunter *et al.,* 2004). Once the required amount of oestradiol is attained, LH is released from the anterior pituitary triggering ovulation.

The theca and granulosa cells which have collapsed and left behind as a result of the freshly ovulated follicle, lutuinize to form the corpus luteum. The developed corpus luteun, then starts to secrete progesterone (Senger, 2003).
The functions and morphologic life of the corpus luteum undergoes luteolysis by the action of prostaglandinf2$\propto$ produced by the uterus if pregnancy did not occur in the polyestrous female sheep. Progesterone starts to decline as a result of the regression of the corpus luteum, the formed block on the follicle is

removed paving way for the development of new follicles completing the estrous cycle (Aiello, 1998).

2.4.3 Pregnancy

If there is fertile mating, it results in the young mammalian which undergoes intrauterine development until parturition. The pregnancy period is usually defined as the period from conception to parturition. The intervening period between fertile mating and parturition is known as gestation period (Jainudeen and Hafez, 2000). An animal is assumed to be pregnant if it did not return to estrus after successful mating or through artificial insemination. Hafez *et al.,* (2000), and Pineda (2003) have reported gestation length of 140-159 days in sheep.

2.4.4 Gestation Length

Gestation is the period from fertilization to delivery of the foetus (Ibrahim, 1998). Gestation length is species-specific and varies within a narrow range (5-10%) for the different breeds of a species (Stewart, 1991). 40% of the variance in gestation length in flocks was due to genetic difference (Terril and Hazel (1947). Factors that influence gestation length include genetic factors, foetal factors, environmental factors and maternal internal environment. Jainudeen and Hafez (2000) stated that age of the animal and parity has influence on the

gestation length. They observed that a sheep that is eight years or older have their gestation of 148 on the average, extended by two (2) days.

Salifu (2014) stated that gestation length decreased from the third parity to the fifth parity (146.8) to 145.9 days) and then increased from the fifth parity to the eighth parity (145.9 to 149.7 days) Chukwuka *et al.,* (2010) reported gestation length of 145 – 148 days for WAD sheep and goats. Ngere *et al.,* (1979) Adu (1972) Dettmers *et al.,* (1976) reported 147 days for WAD sheep. Ososanya *et al.,* (2007) worked with 16 primiparious WAD ewes and reported gestation length of 147-152. Salifu (2014), Obese (1994), Mukasa – Mugerwa *et al.,* (1994), Ibrahim (1998), Jainudeen and Hafez (2000) and Senger (2003) reported gestation lengths of sheep ranging from 145-152 days. White and Termonth (1970) and Uwechue (2000) reported gestation length of 144-155 days and stated that low plane of nutrition prolonged gestation in most sheep breeds.

During the second and third months of pregnancy, a change in ewe's weight becomes more difficult to interpret because of the increase in her weight due to fetal products (fetus, uterine wall, placenta, fluid etc). Taking into account this increase in weight due to the uterus and its contents, an acceptable body weight change during the second and third months of pregnancy would be a net loss of between 4.5 to 9 pounds (3-6% of ewe's body weight)(McCann undated).

Orr and Treacher (1989) reported that the level of concentrate feeding during pregnancy significantly affect all the aspects of performance. He also observed that gains in late pregnancy and losses of body condition were smaller with each increment in the amount of concentrate offered.

Ososanya *et al.,* (2007) in their research with broiler liter fed as a supplement to assess the performance of the pregnant ewes reported that all the ewes gained weight with the highest gain from animals on ration of 5.3kg and the least 4.1kg. They however said that those values reflect and shows the increase in dam body weight due to pregnancy and not total weight gains. Bratte (2015) did a research on lambing interval in zero-weaned West-African Dwarf (WAD) ewes reared intensively with rams in a humid tropical environment and recorded mean ewe live-weight gain to lambing of 4.88 ± 0.39 while Ososanya *et al.,* (2007) recorded mean live-weight to lambing of 4.1± 0.3 – 5.3± 0.2 on his research on pregnant WAD ewes with 4 treatments.

2.4. 5 Lamb birth weight

Birth weight is the weight of the lamb taken immediately after lambing. It is the weight of the newly born animal before it takes in milk (Koney, 2004). It is always necessary to achieve high birth weight on the basis that high birth weight correlate negatively with lamb mortality; heavier lambs record higher survival rates than lighter ones (Yapi *et al.,* 1990; Mukasa-Mugerwa *et al.,* 1994). Abassa (1995) stated that higher birth weights are associated with vigor

and vitality in the lamb. The chances of lamb survival tend to reduce considerably when the lamb is Ikg or less (Mukasa-Mugerwa *et al.,* 1994).

The influence of nutrition on birth weight starts in the uterus, where the foetus has to rely on the dam's supply of nutrients to grow and develop. How severe under nutrition impacts birth weights depends on the stage of gestation at which the dam experiences nutritional deficit (Addah and Karikari, 2008).
Poor nutrition during the first two trimesters of pregnancy interfers with proper "programming" of the foetus and the development of the placeta and accumulation of foetal fluids.

A moderate restriction in nutrition in mid-pregnancy for animals already in good body condition is usually advantageous to the developing foetus in that the placenta expands in a bid to extract more nutrients from the mother, leading to a larger sized lamb. This knowledge has been exploited for years by sheep owners (Eriksson *et al.,* 2012). Generally, the lambs born to pluriparous ewes are heavier than the lambs born to primiparous ewes (Tua and Baah, 1985; Benyi *et al.,* 2006). They maintained that the larger uteri and placentas of old ewes could, respectively accommodate larger foetuses and ensure the supply of more nutrients to the foetus than the relatively smaller uteri and placentas of younger ewes. Younger ewes which are still growing tend to partition nutrients to favour the dam at the expense of the foetus resulting in smaller birth weights (Addah and Karikari 2008).

Differences in birth weights between species, breeds and strains are a result of genetically determined differences in the rate of cell division (Jainudeen and Hafez, 2000). Fall *et al.,* (1982), Hafez *et al.,* (2000), Koney (2004) and Gardner *et al.,* (2007) were of the opinion that variations in lamb birth weights are attributed to the type of breed, nutrition, season of lambing, parity of dam, type of birth (litter size) and sex.

Mean birth weights of 1.77kg was reported by Tua and Baah (1985) while Obese (1994) reported mean birth weights of 1.7± 0.24kg for WAD sheep in the humid zone of Ghana. 1.59kg mean birth weight was reported by Fall *et al.,* (1982) in Senegal for the same breed of animal. An average weight of 2.44kg was reported by Kabugah and Akowuah (1991) for Djallonke x Sahelian cross breeds while 2.0kg mean birth weight was reported by Mukassa – Mugerwa (1994) for Menz lambs in Ethiopia.

Odubote (1992) reported average birth weight of 2.15± 0.46 in Djallonke (WAD) kept at Ile-Ife. Ngere and Aboagye (1981) reported a birth weight of 1.3kg in Ghana while Ngere *et al.,* (1979) reported 1.5kg in Ibadan. Salifu (2014) reported mean birth weight of 1.56kg for Djallonke lambs while Bratte (2015) reported mean birth weight of 1.90± 0.10kg for WAD in Asaba. Fadare (2015) reported 2.82, 3.43 and 2.77kg for black-brown and white-coloured WAD sheep respectively.

Differences in locations, seasons, nutrition, management practices and parity may account for these disparities.

2.4.6 Litter Size

Prolificacy is defined as the average litter size or the number of young produced per parturition. Land (1978) reported that sheep have the highest differences between breeds for this trait. Evans (2003) stated that it is the function of the ovulation rate which sets the upper limit for the number of offsprings per birth and that prolificacy is relatively consistent within breeds. Within breeds, age has been found to exert some influence on prolificacy .Tua and Baah (1985) stated that prolificacy increased significantly from 1.04 among ewes lambing for the first time to 1.6 by their sixth year and the prolificacy declined from the sixth year onwards. The same observation was made by Hoque *et al.,* (2002) and Hanford *et al.,* (2006). Hoque *et al.,* (2002) observed that the prolificacy of ewes increased significantly from 1.64 to 2.20 between the first and fourth parity while Hanford *et al.,* (2006) reported that litter size increased from 1.23 in the first parturition to 2.15 in the sixth parturitions, after which litter size began to decline.

Ibrahim (1998) reported average litter size of 1.14.Litter size of 1.31, 1.30 and 1.4 for Djallonke sheep in Senegal, Ghana and Coted'Ivoire were reported by Fall *et al.,* (1982), Tua and Baah (1985) and Gbangboche *et al.,* (2006) respectively. Bratte (2015) recorded litter size of 1.14 in WAD sheep while

Balogun *et al.,* (1993) reported litter value of 1.22± 0.01 lambs. Odubote (1992) reported litter size at birth of 1.33± 0.41kg in WAD sheep in Ile-Ife.

2.4.7 Post partum return to estrus

The puerperium is the period between parturition and the return to the normal cycling state of the ovaries and uterus. This is a time of uterine involution when the muscles of the uterus contract to void lochia and bacteria that get into the reproductive tract during the parturition process (Senger, 2003). Uterine involution is normally expected to be completed between 20 to 30 days in sheep (Senger, 2003). After parturition comes a period of acyclicity. This acyclicity according to Fray (1995) and Senger (2003) depends on the length of uterine involution, intensity of sucking, body condition score, health status of the animal, season and breed.

GnRH and LH secretion and refractory anterior pituitary are low during the acyclicity period as observed by Noakes *et al.,* (2001).

If lambing interval of 6 months is to be achieved in ewe, the ewe must conceive within 35 d of parturition. Resumption of ovarian cyclicity is of economic importance in the production of sheep. According to Fray *et al.,* (1995) a prolonged post partum return to estrus results in reduced reproductive efficiency

in sheep and this was observed by Yavas and Walton (2000) and Obese *et al.,* (2009) as a source of economic loss.

In the ovaries, follicular development during post partum anoestrus is common but ovulation is unusual and even when it occurs, it is silent. Failure of the follicular maturation and ovulation has been attributed to inadequate production of LH, resulting from inadequate GnRH synthesis and secretion. As a result, basal LH levels and pulse frequency of episodic LH secretion are inadequate to stimulate normal ovarian function (Wright *et al.,* (1981).

Rhind *et al.,* (1989), Wade and Shneider (1992) stated that energy status is generally considered to be the major nutritional factor that influences reproductive processes, with prolonged low energy intake impairing fertility. Rhind *et al.,* (1989) went further to say that inadequate hypothalamic (GnRH) secretion leads to decreased LH pulse frequency resulting in lower ovulation rates in sheep. Salifu (2014) reported 69 days of post partum return to ovarian activity and estrus on WAD ewe while Mbayahaga *et al.,* (1998) reported 77 days post partum return to cyclical activity on Burudian ewes. Mandiki *et al.,* (1990) observed that it took 44 to 57 days for US Texel ewes to resume cycling after parturition. Kawu *et al.,* (2007) recorded 5 days post partum for multiparous Nigeria Red Sokoto goats. Fasanya *et al.,* (1992) observed 48 days of post partum to estrus in their dietary supplementation in the Savanna Brown goat. Ijabo *et al.,* (2014) recorded 21 days post partum return to ovarian activity for Yankasa ewe.

Kawu *et al.,* (2007 in their study on peripheral serum progesterone in multiparous Nigeria Red Sokoto goats between day one and 30 post partum reported that the ovarian activity in the early post partum period is characterized by fluctuating short-term phases and may resume as early as day 5 post partum in multiparious Red Sokoto goats.

Resumption of full post partum ovarian activity is often preceded by silent ovulations and regular estrous cycles. Noakes *et al.,*(2001) observed that the first post partum estrus is generally short and anovulatory and that the first post partum ovulations are not usually associated with overt estrus. 66% of ewes returning to ovarian cycle activity after parturition were observed to exhibit silent ovulations (Mukasa – Mugerwa and Zere, 1991).

Mbayahaga *et al.,* (1998) reported that Burundian ewes showed progesterone profiles that displayed silent ovulation. Some silent ovulations are characterized by the presence of ovarian follicles that luteinized and attained progesterone – secreting ability without ovulation (Edey *et al.,* 1978 Bartlewski, 1999).

2.4.8 Progesterone in reproduction

Progesterone (p4) is a steroid hormone secreted by the luteal cells of the corpus luteum and the adrenal gland (Hafez *et al.,* 2000). Blood progesterone is the key hormone of pregnancy and this is often called the pregnancy "hormone". Progesterone is the important reproductive hormone necessary for the initiation and maintenance of pregnancy in female animals (Malau – Aduli

et al., 2004). During gestation, the placenta also produces large amounts of the hormone to supplement the output from the corpus luteum. Progesterone is required to prepare the endometrium for implantation and plays the role of inhibiting motility of the myometrium to maintain pregnancy (Hafez *et al.,* 2000). It stimulates the growth and secretions of the endometrial glands, causes the cervix to close to variable degrees according to species and induces the sexual behaviour appropriate to pregnancy (Salifu, 2014). It inhibits estrus and the ovulatory surge of LH when in high amount.

Blood progesterone levels directly reflect the activity of the corpus luteum; which means that monitoring levels of progesterone is a reliable means of keeping tract of ovarian activity (Ball and Peters, 2004). During Pregnancy, P4 remains high in circulation and declines towards parturition due to prostaglandinF2∝ release (Khanum *et al.,* 2008). P4 is also present at varying levels during the estrous cycle, being low on day 0 (estrus), increases progressively to some extent and peaks at day 12 (mid cycle), maintained till day 15, and then declines thereafter (Khanum *et al.,* 2008), due to prostaglandin induced luteolysis signaling the proestrus of the succeeding cycle.

During the post partum period early resumption of ovarian activity is a critical event for determining the parturition interval in domestic animals. Shorter parturition intervals will increase the lamb, kid and calfcrop, in sheep, goats and cattle respectively (Ijabo *et al.,* 2014). P4 in blood can therefore be used as an indicator of commencement of cyclicity following parturition and the

chances of rebreeding will therefore result in increased life time productivity of ruminant species (Ijabo *et al.,* 2014). Being the most accurate indicator of cyclic activity in domestic animals and the most predominant hormone during pregnancy, P4 in serum can be used to diagnose pregnancy and determine the stage of the estrous cycle (Oyedipe *et al.,* 1986).

Malau – Aduli *et al.,* (2004) reported that crop-residue supplementation of pregnant Red Sokoto does influenced birth weight and weight gain of kids, daily milk yield but not the progesterone profile while Malau-Aduli *et al.,* (2005 reported) that progesterone concentration on Red Sokoto goats after sexual maturity was between 1-8ng/ml. Fasanya *et al.,* (1992) reported that the type of supplements offered to Savanna goats influenced the levels of their progesterone concentration during their pregnancy period. Lamond (1970), Salisbury *et al.,* (1978) all reported the effect of poor nutrition on the neuro-endocrine system. Early embryonic death can be indicated when P4 declines beyond expected day of estrus. This could also be as a result of season (dry season when feed is scarce (Llewely *et al.,* 1992).

2.5 Potentials of cassava as animal feed

To a limited extent, it is used as a livestock feed, particularly in non-ruminant diets (Smith, 1988).

Cassava is one of the world top calorie products for human consumption generally, grown without fertilization on soils with poor fertility where other crops would fail (Howeler and Cadavid, 1990).

Cassava can survive prolonged water deficit (Alves and Setters, 2000) and is tolerant to acid soils but the yield is limited by poor phosphorus (p) supply (Howeler, 1985). It is also one of the most potentially valuable tropical crops due to its high tuber yield and simplicity of cultivation. However, it has been shown that the fertility of the soil decreases after the cultivation of cassava for root production without fertilization (Ngiki *et al.,* 2014). Howeler(1991) went further to state that in cassava – producing countries, better soils are almost devoted to more profitable crops,leaving those areas with soil problems for cassava (high aluminum content, low exchangeable base content, high phosphorus fixation and various degrees of erosion). Presently, cassava is widely grown throughout tropical and some subtropical areas (Ngiki *et al.,* 2014). Cassava is generally cultivated for root production for both humans and animals. FAO (2011) put the word production of cassava at about 250 million tonnes, 47% of which is produced in Africa. About 30% of Africa's production is from Nigeria. FAO (2011) went further to state that more than a third of cassava production is used for animal feeding. Cassava root production has been increasing steadily since the 1960s and surged in the 2000s (+40% between 1997 and 2007, from 161 to 227 million tonnes). Its use in animal feeding also grew from 25% in 1997 to 34% in 2007 (76 million tonnes). This is broken down into various continents as follows; Africa 132 million tonnes, Latin America 35 million tones, Asia 82.5 million tonnes and Oceania 277,000 tonnes

and Nigeria 39 million tonnes being the leading producer in the world (FAO 2011).

Table 2.1 World cassava production (tonnes)

Regions	Year 2008 ('000)	Year 2009 ('000)	Year 2010 ('000)	Year 2011 ('000)
World production	239,843	241,980	237,917	250,062
Africa	125,039	123,180	126,627	132,119
Nigeria	44,582	36,804	37,504	38,982
Latin America	34,201	32,773	33,029	35,170
Asia	80,404	85,785	78,086	82,587
Oceania	284	278	271	277

Source: FAO (2011)

Cassava is an important component of the diets of more than 800 million people around the world (FAO 2007) and is the third largest carbohydrate food source within the tropical region, after rice and corn (Ceballos *et al.,* 2004). Cassava is referred to as a food security crop (Barratt *et al.,* 2006), which can be left in the ground for extended periods of up to two years, until required.

The major future market for increased cassava has long been recognized by researchers in Africa as an appropriate animal feed and it has been an important and cheap feed in many European countries. Both roots and leaves are

usable as food for livestock. Cassava is one of the most drought tolerant crops and can successfully grow on marginal soils, giving reasonable yields where many other crops cannot do well (Hahn, 1988). Cassava offers tremendous potentials as cheap source of food energy for animals, provided it is well balanced with other nutrients. There is great deal of current interest in supplementing of animals with cassava in Africa (Hahn, 1988)

Cassava is also used as feed and regularly fed to small ruminants on small-scale subsistence farms in Africa. In recent survey of small holder small ruminant farmers in South West Nigeria, a majority of the farmers indicated that cassava by-products of cassava peels were regularly given to their livestock as increased supplement to grass and hay. The constraint to increased utilization of cassava products as ruminant feed includes the difficulty of obtaining sufficient amounts and the cyanide content. The potential of cassava as a grain substitute in livestock feed is yet to be fully exploited, as only a small proportion of total production is currently used, mainly in compounded non ruminant diets. Not only that ruminants can be fed on tuberous roots, the stem, leaves, peels and the various by-products of tuber processing such as residues from starch, garri and fufu manufacture. The principal products of the mature cassava plant (12 months), expressed as a percentage of the whole part, were estimated as: leaves 60%, stem 44% and tubers 50%. By-products of tuber processing are peel 8% and pomace 17% (Devendra , 1977). Other by-products include residues from the manufacture of garri, fufu and cassava flour (Lafun). The value of any feed,

and the livestock response to such feed, depends on a number of factors including nutrient contents and availability, animal age, physiological state, the species and associative effects of other feeds (Smith, 1988). The cassava tuberous root is low in protein, fat, trace minerals, and vitamins, and therefore mainly a source of energy. The bulk of the tuber (90%) consists of carbohydrates (Seerly, 1772), made up of 34.5% fiber, and 96% nitrogen free extracts (NFE) (Hutagalung et al 1973, Muller *et al.,* 1975).

2.6 Potentials of cassava peel

Cassava peel is an important source of energy in ruminant feeding system, serving either as the main basal diet or as a supplement. It is rarely fed fresh because of the high level of cyanogenic glycoside in the material. Sun drying, ensiling and fermentation are used to reduce the concentration of the glycoside to tolerable levels. Cassava peel makes up 8% of the by-product of tuber processing (Devendra, 1977).

It is estimated that approximately 4 million tonnes of cassava peeling useful as livestock feed are produced annually as a by-product in Nigeria alone during processing of cassava roots (Hahn, 1988).

Cassava peel is low in protein and energy. The peels contain higher levels of cyanogenic glycosides than the root meal (Adegbola and Asaolu, 1986).

Table 2.2 Proximate composition of cassava peel

Constituents	**1**	**2**	**3**	**4**
Dry matter (%)	29.6	-	80.95	-

Crude protein (%)	4.9	4.5	5.5	2.53
Crude fibre (%)	16.6	7.0	21.36	9.03
Ether extract (%)	1.3	2.0	0.67	0.70
Nitrogen free extract	68.5	81.5	66.49	73.83
Ash (%)	5.9	5.0	5.98	3.17
Source:	1. Smith (1992)	2. Onyimonyi and Ugwu (2007)	3. Sogunle *et al.,* (2009)	4. Abu *et al.,* (2015)

As a rough estimate, about 10 million tonnes of cassava are processed for "gari", annually in Nigeria alone (Okafor, 1992). In the processing of cassava fermented products, the roots are normally peeled to rid them of two outer coverings; a thin brown outer covering, and a thicker leathery parenchymatous inner covering. These peels are regarded as wastes and are usually discarded and allowed to rot.

With hand peeling the peels can constitute 20 – 30% of the total weight of the tuber (Ekundayo, 1980). The wastes generated at present pose a disposal problem and would even be more problematic in the future with increased industrial production of cassava products such as cassava flour and dried "fufu". Since these peels could make up to 1% of the wet weight of the roots, they constitute an important potential resource if properly harnessed by a biotechnological system (Obadina *et al.,* 2006). Cassava peel has been a constant part of household waste product and even constitute nuisance in waste disposal. It is traditionally offered to small ruminants in Southern Nigeria (Obioha, 1977). Cassava peel constitute about 8 – 15 percent of the whole root

(Onyimonyi and Ugwu, 2007). The peel of the "bitter" cassava variety was shown to contain an average of 650ppm and the pulp to contain 310 ppm total cyanide. The corresponding values for "sweet" varieties were 200 ppm and 318 ppm respectively (Tewe, 1991).

The HCN content in fresh, sundried and ovendried cassava components are shown in Table 2.3

Cassava products	**HCN (PPM)**
Fresh whole root	88.3 – 416.3
Fresh pulp	34.3 – 301.3
Fresh peel	364.2 – 814.7
Fresh leaves	1436
Sundried whole root	23.1 – 41.6
Sundried pulp	17.3 – 26.7
Sundried peel	264.3 – 321.5
Sundried leaves	173
Oven dried whole root	51.7 – 63.7
Oven dried pulp	23.7 – 31.3
Oven dried peel	666.8 – 1250
Source	Tewe and Iyayi (1989)

2.6.1 A review of some research works on cassava peel

Adegbola *et al.,* (1988) used cassava peel and poultry manure as feed for West Africa Dwarf sheep. He fed dried poultry manure (DPM) at the rate of 0, 13, 25, 35, 45% while dried cassava peels (DCP) and water were provided ad libitum. The efficiency of fed conversion figures ranged between 8.7 and 10.5.

Average total dry matter intake and average growth rate (g/head/day) increased linearly as the feed increased. They stated that feeding up to 55% cassava peels as the main energy sources of the animals in their study did not depress growth rate which averaged 90 – 100g/day for the entire experiment. Fumunyan and Maffeja (1987) conducted experiment in which they fed three levels of dried cassava peel (0, 35 and 70 percent of diet) to sheep combined with pennisetum purpureum at 70.35, and 0 percent of diet respectively. The source of protein was cotton seed cake. The dry matter intake, digestibility and growth rate increased linearly with increasing levels of cassava peel. They therefore concluded that cassava peel – based diets have greater potential as dry season feed stuff for sheep.

Adebowale (1981) reported on the maize replacement value of fermented cassava peels in rations for sheep. He observed that feed intake was depressed significantly ($P<0.05$) in diets containing 40 and 60% fermented cassava peels but non significantly in the 20% diet when compared with control ration (0% cassava peels). There was also depression in the final body weight and average body weight gain. The 20% diet was utilized to the same extent as the control diet and both were better ($P<0.05$) than the other levels. There was also general depression in growth rate and feed utilization particularly on levels 40% and 60%. Adeyanju and Pido (1978) worked on broilers and reported that increasing levels of cassava peel resulted in reduced feed intake, poor feed efficiency and slower growth rate when compared with corn. Sowardi *et al.,* (1975)

supplemented rations fed to heifers with cassava peel and reported that rumen ammonia levels and weight gains were lower when compared with those fed corn supplemented rations. The reduced growth rate might also be due to reduced feed intake, poor digestibility and decreased efficiency of feed utilization as the level of fermented cassava peel increased (Adebowale, 1981). Similar observation was made on chicks by Fawole (1980).

Lakpini *et al.,* (1997) reported that there was significant($P<0.01$) decrease in cassava peel intake as the cassava peel level increased when they fed Red Sokoto goats in their first trimester of pregnancy with graded levels of sun-dried cassava peels in supplement diets. They also reported that there was no significant (>P0.01) difference in the efficiency of feed conversion but the efficiency of crude protein utilization was significantly (<0.01) higher in the cassava peel-based ration than the cotton seed based ration. No significant difference in the live-weight gains of the goats during the first trimester of pregnancy, no abortions and mortalities and they concluded that the use of cassava peels up to 74.0% in supplement rations, which completely replaced maize offals did not affect live weight changes in pregnant goats grazed on native pasture. Walker (1985) reported feeding cassava peels to sheep and goats in Equatorial West Africa with poor response.

Smith (1988) reported that cassava peel is rapidly and well degraded in the rumen. Dry matter losses of 70% (dried peel) and 73% (ensiled peel) in 24 hours in the rumen of sheep. Smith et al (1988) reported high dry matter losses

for cassava peel in the cattle, sheep and goat with a mean value of 83% in 48 hours, an indication that cassava peel could serve as a useful energy feed in ruminant diets.

Otchere *et al.,* (1977) reported that sheep supplemented with cassava peels gained weight and maintained this weight advantage during the following rainy season when the control animals exhibited a high degree of compensatory growth. Asaolu (1988) reported optimum conditions for making good quality cassava peel silage. According to him, good quality silage could be obtained by chopping the peel to equal lengths of about 2cm for easy compaction. By wilting (air drying) for 2 days before ensiling, the moisture contents are reduced from 70-75% to about 40%. According to Asaolu (1988), a reduction of moisture content will ensure good fermentation even if the peels are not chopped to uniform lengths. Under these conditions, cassava peel silage after 21 days was light brown in colour, firm in texture and had a pleasant odour, the pH was 4.4 without fungal growth. Two groups of sheep were fed with such good quality cassava peel. The sheep fed were West Africa Dwarf sheep. The two groups fed were made up of 80% of dried or ensiled peel, supplemented in each case with 20% Gliricidia leaves. A control group was fed only on Gliricidia. When the performance of the two groups were compared, it was found that sheep fed mainly on cassava peel supplemented with small protein-rich Gliricidia efficiently put on weight during this period.

Cassava peel has been used to replace maize as an energy source in the diet of pigs (Iyayi and Tewe, 1988).

Omole and Onwudike (1982) fed 0, 10, 20, 30, 40 and 50% dietary cassava peel meal without dietary palm oil. In another, they included 5% palm oil with the same level of cassava peel meal. Their intention was to investigate the effects of palm oil in cassava peel diets for rabbits. It was observed that dietary palm oil improved live performance in all the treatment including the control that did not contain any cassava peel meal. Inclusion of up to 30% cassava peel meal seemed to cause no significant depression in growth or feed utilization in both studies.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Description of the Experimental Site

The experiment was carried out at Sheep and Goats Project, National Animal Production Research Institute (NAPRI), Ahmadu Bello University, located at Ubiaja, Esan South East Local Government Area of Edo State.

The farm is located on longitude $6^0$8' E and latitude $6^0$42' N in the humid rain belt of Nigeria. The vegetation consists of a variety of species of grasses, shrubs and trees. The area has an average temperature of 31.8^0c and annual rainfall of 2474mm.

3.2 Experimental animals

Twenty four cycling nulliparous West Africa Dwarf ewes aged 12 – 15 months and weighing 9 – 12 kg were used for this study. The animals were obtained from the open market and quarantined for a period of six weeks. The animals were vaccinated against Peste des Petits Ruminants (PPR) using the vaccine obtained from National Veterinary Research Institute (NVRI) VOM. The animals were also covered with long acting antibiotics, dewormed and

dipped in an acaricide against ecto–parasites. The animals were individually identified by means of plastic ear tags and kept in pens per group.

3.3 Experimental design and procedure

The animals were randomly allotted to four groups (i-iv) of six animals per group to receive 0, 2, 4 and 6% of their average body weight of supplementary sun dried cassava peels, respectively. Each group had 3 replicates of 2 animals each. During each feeding time, the animals were offered the supplement first and allowed to finish it before they were subsequently allowed to graze with access to water *adlibitum*.

After an initial adjustment of 14 days, body weights were taken fortnightly for 98 days and the quantity of the sun-dried cassava peels offered adjusted accordingly. Initial and final weight of the animals was taken at the beginning and end of the experiment respectively. The animals received the supplement throughout the non-pregnant and pregnant periods up to 266 days post partum.

Live weights of the ewes were taken using a spring balance at the start of the experiment and they were weighed on a fortnight basis afterwards. The weight gain from each group was calculated by subtracting the initial weight from the final weight. Average daily weight gain was calculated by subtracting

the live weight at the beginning of the fortnight from the live weight at the end of the fortnight and dividing by the number of the days in the fortnight

Cassava peel feed intake was determined by subtracting the total left over from the total weight of cassava peel offered from day one to finish and divided by the number of days fed while daily mean intake was obtained by subtracting the daily left over from the daily supplement given and divided by the number of the ewes in the replicate.

Efficiency of cassava peel utilization was defined as kilogram of weight produced per kilogram of dry matter (DM) consumed during the same period of time.

The proximate analysis of the sun-dried cassava peels was undertaken

The effects of the supplement on duration of estrus, length of estrous cycle and pregnancy and post-partum resumption of ovarian activities were determined.

3.4 Proximate analysis of the cassava peels

The proximate analysis of sun dried cassava peel was carried out at the Delta State University Research Laboratory, Asaba Campus using the A.O.A.C (1990) procedures.

Moisture content

2mg of ground sun-dried cassava peel sample was weighed accurately into a shallow silica dish that had been previously ignited at 500 – 600^0c in a

muffle furnace for 30 minutes. The dish containing the sample was placed in the thermostatic air oven set at 105^0c for 24 hours. It was then cooled in a dessicator for 30 minutes and weighed. The sample was returned to the oven for another 24 hours and again cooled in the dessicator, weighed quickly and accurately. The percentage moisture was calculated thus:

$$\frac{Weight\ of\ moisture}{Weight\ of\ sample} \ x\ \frac{100}{1}$$

The dish with the dry sample was reserved for total ash determination. This was charred on an electric heater at low heat with caution not to inflame it. The heat was increased, until a glow went all over the residue which on cooling was transferred to a thermostatic muffle at 600^0c for 30 minutes, when the ash became grey powder but not fussed. It was cooled in a dessicator and weighed. The percentage of total ash was calculated thus:

$$\%\ \text{total ash} = \frac{Weight\ of\ ash\ alone}{Weight\ of\ sample\ used}\ x\ \frac{100}{1}$$

For ether extraction, a gram of the sample was weighed into a fat extraction thimble, which was placed in a soxhlet extractor. The extractor was fitted into the round glass mouth of the soxhlet flask (to be dried in an oven, cooled and weighed) and a double surface condenser was fitted in turn into the extractor. Then a flask ¾ filled with petroleum ether was placed in a heater. The extraction process went on for about 7 hours, after which the ether was maximally recovered. The flask was removed and oven dried over night (to

remove the last traces of water and ether from the flask), then cooled and weighed.

$$\% \text{ Ether Extract} = \frac{Weight\ of\ flask\ and\ oil - weight\ of\ flask}{Weight\ of\ sample} \ x\ \frac{100}{1}$$

Crude fibre determination, the fat extraction which was the content of the dry thimble was transferred into a conical flask to which was added diluted sulphuric acid and sodium hydroxide solution, one after the other and then brought to a boil. After series of washing the reacting substances with methyleted spirit and petroleum ether, the residue was placed in a silica dish and dried in an oven overnight, then cooled and weighed. The residue was charred and ignited in a muffle furnace to complete ash, cooled and weighed.

$$\%\ crude\ fibre = \frac{Weight\ of\ dish + fibre - weight\ of\ dish + dish\ silica}{Weight\ of\ sample} \ x\ \frac{100}{1}$$

Crude protein (CP) was determined by Kjeldahl method whereby the sample in Kjeldahl flask was digested with the following chemicals: anhydrous sodium thiosulphate, copper sulphate a trace of selenium powder and concentrated sulphuric acid with the aid of glass beads. Heating continued until cessation of frothing and resultant bright greenish blue solution was obtained. Distilled water was added and transferred to a 250ml graduated flask, which was made up to the volume with distilled water and shaken vigorously to mix. Then using Markem Apparatus with subsequent titration, the percentage crude protein was calculated.

$$\% \text{ CP} = \frac{4.375 \; x \; Titre \; Values}{Sample}$$

Nitrogen free extract (NFE) percentage was calculated using the following formular: %NFE =100 – (% CP + % CF + % EE + % Ash + % Moisture)

3.5 Synchronization of estrus using EAZI – BREED CIDR®

All the ewes were synchronized for estrus using EAZI – BREED^{TM} CIDR®, a sheep and goat device, an inert silicone elastomer impregnated with 0.3g natural progesterone. The device was inserted into the vagina of each ewe with the aid of the device applicator. After loading the applicator, the tip was lubricated with glycerol and then inserted through the vulva into the vagina. The applicator plunger was pressed to release the device, leaving the cord protruding from the vulva. The device was allowed in place for 14 days after which it was removed by pulling the removal cord/drawing string.

3.6 Determination of estrus and estrous cycle length

The ewes were synchronized for estrus using progesterone impregnated intra uterine device (PRID) for 14 days. Following PRID withdrawal estrus was observed both visually twice daily (0800-1100; 1500-1800) and by apron fitted rams for 5 days. Standing to be mounted by the rams (heterosexual mounting) or other female (homosexual mounting) was taken as estrus manifestation. A ratio of one ram to ten ewes (Abiodun, 1998) was used to ensure adequate

detection of heat by the rams. Duration of estrus was estimated as the interval between the time the animal first stood for mounting and the last time of standing for mounting.

Following the removal of the device from the animals, 5mls of jugular vein blood samples were taken every two days for forty five days to determine the estrous cycle length through the peripheral serum progesterone levels. The interval from one estrus to another was taken as the length of the estrous cycle.

3.7 Determination of the effects of sun-dried cassava peel on gestation

The synchronized animals were mated following the removal of the device on the 14^{th} day. The mated animals were watched if any of them would return on heat.

Jugular vein blood samples were taken every two weeks beginning from day 47 to day 145 to determine the effect of the supplement on pregnancy through peripheral serum progesterone levels. The interval from mating to parturition was taken as the length of the gestation.

3.8 Determination of the effects of sun-dried cassava peels on post – partum ovarian activities

Five (5) mls of jugular vein blood samples were taken from the ewes from the day they lambed and every other day for 70 days to determine post – partum resumption of ovarian activities through blood progesterone levels. A

progesterone level of 0.5ng/ml and above was taken as an indication of a functional corpus luteum and thus ovarian activity.

3.9 Blood sample processing

Blood samples of the animals were taken before feeding. During each bleeding time which was a separate day from the day of live weights recording, 5ml of blood was collected from each animal by jugular vein puncture. It was allowed to clot and serum was harvested into 5ml blood vials and stored immediately in a deep freezer ($^{-}20^{0}$c) until radio immuno – assay for progesterone.

3.10 Assay procedure

The assay procedure was carried out at Hormone Laboratory, Biotechnology Research Programme, National Animal Production Research Institute (NAPRI) Ahmadu Bello University Zaria.

Serum progesterone concentration was estimated by a microplate Enzyme Immuno assay colorimetric procedure (Accu–Bind ELIZA Microwells, progesterone Test System Product Code 4825 – 3000).

The standards were first arranged in ascending order of 0.0, 0.3, 2.0, 5.0, 15.0, 30.0 and 60.0 in duplicates in the ELIZA ASSAY SHEET.

The microplate wells for each serum reference calibrator/standards and samples to be assayed were arranged. The wells for the standards (serum reference calibrator) were arranged in duplicates occupying the first 14 rows

followed by the sample wells. 0.025ml (25µL) of the appropriate serum reference calibrator and serum were pipetted into the assigned wells after mixing each in a vortex mixer. The serum sample was allowed to thaw before mixing. 0.05ml (50 µl) of progesterone enzyme reagent (conjugate) was added to all the wells. The micro plate was swirled gently for 10 – 20 seconds to mix. It was covered and incubated for 60 minutes at room temperature. The contents of the microplate were discarded by decantation and the plate were blotted dry with absorbent paper.

0.050ml (50µl) of wash buffer (taken after diluting 20ml of wash concentrate with 980ml of D_1 water) was added, decanted and blotted. This was repeated two additional times for a total of three washes using a manual washer. 0.100ml (100µl) of substrate solution was added to all wells and incubated at room temperature for 20 minutes. After this, 0.050ml (50µl) of stop solution was added to each well and gently mixed.

The absorbance in each well was read at 450nm (using a reference wave length of 620 – 630nm). The sensitivity of the assay was 0.105 ng/ml while intra and inter assay coefficients of variation were 3.8% and 7.5 % respectively.

A dose response curve was used to ascertain the concentration of progesterone in unknown samples. The absorbance obtained from the printout of the microplate reacher was recorded. The absorbance for each duplicate serum reference versus the corresponding progesterone concentration was plotted in ng/ml on linear graph paper. The points were connected with a best –

fit curve. The concentration of progesterone for an unknown was determined by locating the average absorbance of the duplicates for each unknown on the vertical axis of the graph, while the intersecting point on the curve was found and the concentration read (in ng/ml) from the horizontal axis of the graph.

3.11 Statistical Analysis

All data collected were subjected to a One – Way ANOVA analysis of variance. Means showing significant differences were separated using Duncan's Multiple Range Test (Duncan, 1980).The SPSS (v20) statistical package of 2011 was used for all statistical analysis.

CHAPTER FOUR

4.0 RESULTS

4.1 Proximate composition of sun-dried cassava peels

The result of the proximate analysis of the sun-dried cassava peels is presented in table 4.1. Moisture content was 13.3%, ether extract 8.7%, crude fibre 5.55%, crude protein 6.56%, ash 6.4% and nitrogen free extract 59.44%.

Table 4.1: Proximate composition of experimental cassava peel

Parameters	Percentage (%)
Moisture content	13.30
Ether extract	8.70
Crude fibre	5.55
Crude protein	6.56
Ash content	6.40
Nitrogen free extract	59.49

4.2 Effects of feeding varying levels of sun-dried cassava peels as supplement on body weights of nulliparous West African Dwarf ewes

The results of feeding varying levels of sun-dried cassava peels on the body weight of nulliparous West African Dwarf ewes are presented in table 4.2. The results showed that the mean final body weight of ewes that received 6% feed supplement was significantly higher ($P<0.05$) than those that received 0% supplement but similar to those that received 2 and 4%.

The mean body weight gain for ewes that received 6% supplement level was significantly higher ($P<0.05$) than those that received 0, 2 and 4%. The weight gain by animals that received 4% supplement was significantly higher ($P<0.05$) than those that received 0 and 2% levels while the gain for 0 and 2% levels were similar .

The mean daily weight gain showed a similar pattern to that of the mean body weight gain.

The daily and mean cassava peel intakes showed significant variations between the supplement levels. While 6% level was significantly higher (<0.05) than 2 and 4%, 4% was significantly higher ($P<0.05$) than 2% supplement level.

The efficiency of cassava peel utilization decreased with the increasing levels of the supplement.

Animals that received 2% supplement utilized the cassava peel more efficiently than those that received 4 and 6%. The animals that received 4% supplement utilized the peel better than those that received 6%.

4.3 Effects of feeding varying levels of sun-dried cassava peel as supplement on body weights of West African Dwarf ewes during pregnancy and postpartum period

The results of feeding varying levels of sun-dried cassava peels as supplement on the body weight of West African Dwarf ewes during pregnancy and postpartum period are presented in tables 4.3 and 4.4.

The results showed that there was no significant ($P>0.05$) difference on the mean final body weight of all the animals that received the cassava peel supplement in all the groups during pregnancy and postpartum period.

The weight gain during pregnancy and postpartum varied significantly between the supplement levels. The gain to lambing by animals that received 6% supplement was significantly higher ($P<0.05$) than those that received 0, 2 and 4% levels. The gain to lambing by the animals that received 4% supplement was significantly higher ($P<0.05$) than those that received 0 and 2% while the gain to lambing by the animals that received 2% was significantly higher ($P<0.05$) than those that received 0% supplement.

The mean postpartum body weight of the animals that received 6% feed supplement was significantly higher ($P<0.05$) than those on 0% level while the values of the mean body gain for the animals that received 6, 2 and 4% levels were similar.

The mean daily body weight gain during pregnancy for ewes that received 6% supplement level was significantly higher ($P<0.05$) than those that received

0, 2 and 4%. The mean daily body weight gain for ewes that received 4% supplement level was significantly higher ($P<0.05$) than those that received 0 and 2% while the mean daily body weight gain of the animals that received 0 and 2% were similar.

The mean postpartum daily body weight gain for the animals that received 6 and 4% supplement were similar while those that received 0 and 2% were similar.

The mean cassava peel intake during pregnancy for animals that received 6% feed supplement was significantly higher ($P<0.05$) than those that received 2% but similar to those that received 4%. The daily cassava peel intake for ewes that received 6% supplement level was significantly higher ($P<0.05$) than those that received 2% but similar to those that received 4%. The mean postpartum cassava peel intake for the animals that received 6% supplement was significantly higher ($P< 0.05$) than those that received 2 and 4% while the mean cassava peel intake for the animals that received 4% supplement was significantly higher ($P< 0.05$) than those that received 2% level.

The mean postpartum daily cassava peel intake for the animals that received 6% feed supplement was significantly higher ($P<0.05$) than those that received 2 and 4% levels while the mean daily cassava peel intake for the animal that received 4% level was significantly higher ($P<0.05$) than those that received 2%.

The efficiency of cassava peel utilization also showed that the animals that received 2% supplement during pregnancy utilized the cassava peel more efficiently than those that received 4 and 6%. The animals that received 4% supplement utilized the peel better than those that received 6%. The efficiency of cassava peel utilization decreased with the increasing levels of the supplement. The results of the efficiency of cassava peel utilization postpartum showed that the cassava peel was more efficiently utilized by the animals that received 2% than those that received 4 and 6% respectively. The efficiency of cassava peel utilization decreased as the levels increased.

Table 4.2: Mean body weights, weight gains, cassava peel intake and utilization of non-pregnant nulliparous West African Dwarf ewes fed varying levels of sun-dried cassava peels as supplement

Variables	i(0%)	ii(2%)	iii(4%)	Iv(6%)
Mean initial body weights (kg)	10.00 ± 0.63^{a}	10.00 ± 0.58^{a}	10.00 ± 1.34^{a}	10.00 ± 1.67^{a}
Mean final body weights (kg)	11.67 ± 0.68^{b}	12.00 ± 0.55^{ab}	12.83 ± 0.54^{ab}	13.92 ± 0.76^{a}
Mean body weight gain (kg)	1.67 ± 0.17^{c}	2.08 ± 0.24^{c}	2.83 ± 0.17^{b}	3.92 ± 0.33^{a}
Mean daily weight gain (kg)	0.02 ± 0.00^{c}	0.02 ± 0.00^{c}	0.03 ± 0.00^{b}	0.04 ± 0.00^{a}
Mean cassava peel intake (kg)	ND	19.83 ± 0.58^{c}	28.09 ± 2.06^{b}	43.31 ± 3.27^{a}
Mean daily cassava peel intake (kg)	ND	0.20 ± 0.01^{c}	$0.29^{\pm}0.02^{b}$	0.44 ± 0.04^{a}
Efficiency of cassava peel utilization(kgfeed/kggain)	ND	9.4	10.0	11.1

a,b,c: Means within a row with different superscripts are significantly different ($P<0.05$), ND: Not determined

Table 4.3: Mean body weights, weight gains, cassava peel intake and efficiency of utilization in pregnant West African Dwarf ewes fed varying levels of sun-dried cassava peels as supplement

Variables	i(0%)	ii(2%)	iii(4%)	iv(6%)
Mean initial body weight (kg)	12.00±0.80^{a}	12.00±1.14^{a}	12.000.80^{a}	12.00±1.14^{a}
Mean final body weight (kg	15.67±0.81^{a}	16.08±1.14^{a}	16.67±0.70^{a}	17.42±1.01^{a}
Mean gain to lambing (kg)	3.67±0.17^{d}	4.08±0.08^{c}	4.67±0.11^{b}	5.42±0.15^{a}
Mean daily body weight gain (kg)	0.04±0.00^{c}	0.04±0.00^{c}	0.05±0.00^{b}	0.06±0.00^{a}
Mean cassava peel intake (kg)	ND	23.27±1.33^{b}	32.94±2.62^{ab}	39.23±4.95^{a}
Mean daily cassava peel intake (kg)	ND	0.24±0.01^{b}	0.34±0.00^{ab}	0.40±0.05^{a}
Efficiency of cassava peel utilization (kg feed/kg gain)	ND	5.7	7	7.3

a,b,c: Means within a row with different superscripts are significantly different ($P<0.05$), ND: Not determined

Table 4.4: Mean body weights and cassava peel intake by West African Dwarf sheep during the post partum period

Variables	i(0%)	ii(2%)	iii(4%)	iv(6%)
Mean initial body weight (kg)	14.35±0.84^{a}	14.38±1.07^{a}	14.80±0.63^{a}	15.63±1.03^{a}
Mean final body weight (kg)	15.63±0.84^{a}	15.83±1.01^{a}	16.58±0.49^{a}	17.58±0.86^{a}
Mean body weight gain (kg)	1.28±0.11^{b}	1.45±0.13^{ab}	1.78±0.19^{ab}	1.95±0.20^{a}
Mean daily body weight gain (kg)	0.02±0.00^{b}	0.02±0.00^{ab}	0.03±0.00^{a}	0.03±0.00^{a}
Mean cassava peel intake (kg)	ND	15.18±0.65^{c}	20.61±1.14^{b}	24.60±0.43^{a}
Mean daily cassava peel	ND	0.22 ±0.01^{c}	0.29 ±0.01^{b}	0.35 ±0.01^{a}

intake			
Efficiency of cassava peel utilization (kg feed/kg gain)	ND	10.12	11.45	12.0

a,b,c: Means within a row with different superscripts are significantly different (P<0.05)
ND: Not determined

4.4 Effects of cassava peel supplement on estrus duration, estrous cycle length and progesterone concentration for non-pregnant and pregnant West African Dwarf ewes

The results of the effect of feeding varying levels of sun-dried cassava peel on estrus duration, estrous cycle length and progesterone concentration for non-pregnant and pregnant ewes are presented in table 4.5. Estrus duration of the animals that received 6 and 4% supplement levels were significantly longer (P<0.05) than those that received 2% but similar to those animals that received 0%. The estrous cycle length of the animals that received 0, 4 and 6% cassava peel supplement were significantly longer (P<0.05) than those of the animals that received 2%.

The results showed that the mean progesterone concentration of non-pregnant ewes that received 6% supplement level was significantly higher (P<0.05) than those that received 2% but similar to those that received 0 and 4%. Progesterone concentration for pregnant animals that received 6% supplement was significantly higher (P<0.05) than for those that received 0, 2 and 4% levels while the mean progesterone concentration for those that received 0, 2 and 4% levels were similar .

Table 4.5: Estrus duration, estrous cycle length and serum progesterone levels for non-pregnant and pregnant ewes

Variables	i(0%)	ii(2%)	iii(4%)	iv(6%)
Mean estrus duration (hrs)	25.17±0.40^{ab}	24.33±0.21^{b}	25.83±0.40^{a}	26.17±0.54^{a}
Mean estrous cycle length(days)	18±0.00 ^{a}	12.00±0.20^{b}	17.00±1.41^{a}	20.00±0.00^{a}
Mean progesterone concentration (ng/ml) for non-pregnant ewes	1.44±0.23^{ab}	1.02±0.11^{b}	1.42±0.25^{ab}	2.19±0.44^{a}
Mean progesterone concentration(ng/ml) for pregnant ewes	13.68±0.31^{b}	13.84±0.44^{b}	14.24±0.34^{b}	14.68±0.43^{a}

a,b,c: Means within a row with different superscripts are significantly different ($P<0.05$)

4.5 Effects of cassava peel supplement on pregnancy duration, litter size and post partum resumption of ovarian activities.

Reproductive parameters of pregnant West African Dwarf ewes fed varying levels of sun-dried cassava peels as supplement are presented in table 4.6.

There was no significant difference in the mean pregnancy duration for the ewes in all supplementation groups. However the animals that received 6% feed supplement had the shortest pregnancy length (150.17±0.30) while the

animals that received 0% of the supplement had the longest pregnancy length (154.33±1.20).

The mean weight of lambs at birth showed significant ($P<0.05$) variations between the supplement levels. The mean weight at birth for the ewes that received 6% feed supplement was significantly higher ($P<0.05$) than those that received 0, 2 and 4%. The mean weight at birth for the ewes that received 4% Supplement was significantly higher ($P<0.05$) than those that received 0 and 2% while 2% was significantly higher ($P<0.05$) than 0% supplement.

All the ewes irrespective of supplementation levels had single birth resulting in 6 lambs for each supplement level. There were no twins recorded in this study. The total number of lambs recorded in this study was 24 lambs. The results of the ratio of M:F lambs showed that the animals that received 0% feed supplement recorded 33.3:66.7%(2 males, 4 females), 2% supplement level recorded 33.3:66.7% (2 males, 4 females), 4% supplement level recorded 33.3:66.7% (2 males, 4 females) while 6% supplement level recorded the highest number of females in the ratio of 16.7:83.3% (1 male, 5 females). There was no mortality or abortion recorded throughout the duration of the study.

Table 4.6: Reproductive parameters of pregnant West African Dwarf ewes fed varying levels of sun-dried cassava peels as supplement

Variables	i(0%)	ii(2%)	iii(4%)	iv(6%0
Mean pregnancy duration (days)	154.33±1.20[a]	151.83±0.70[a]	152.00±0.37[a]	150.17±0.30[a]
Mean weight of lambs at birth (kg)	0.97±0.04[d]	1.14±0.04[c]	1.25±0.03[b]	1.42±0.03[a]
litter size	1	1	1	1
No of lambs in each inclusion level	6	6	6	6
Ratio of twin: single (%)	0:100	0:100	0:100	0:100
Ratio of M:F lambs (%)	33.3:66.7	33.3:66.7	33.3:66.7	16.7:83.3
Lamb mortality/abortion at birth (%)	0	0	0	0

a,b,c: Means within a row with different superscripts are significantly different (P<0.05)

4.6 Post partum return to estrus and post partum estrous cycle length

The result of the effects of feeding varying levels of sun-dried cassava peels as supplement on post partum return to estrus and post partum estrous cycle length is presented on table 4.7. There was no significant difference in post partum return to estrus between the animals in all supplement levels.

The mean estrous cycle length for the animals that received 6% supplement was longer (P<0.O5) than the lengths for those that received 0, 2 and 4% levels while the length for the animals on 0% supplement was longer than those of

animals that received 4% but similar to that of the animals that received 2% supplement.

Table 4.7: Effects of feeding varying levels of sun-dried cassava peels as supplement on post partum to estrus and post partum estrous cycle length of West African Dwarf ewe

Variables	i(0%)	ii(2%)	iii(4%)	iv(6%)
Post partum to estrus (days)	9.00 ± 5.00^{a}	8.00 ± 2.00^{a}	4.00 ± 0.00^{a}	7.00 ± 0.00^{a}
Post partum estrous cycle length(days).	12.00 ± 2.00^{b}	9.00 ± 1.00^{bc}	7.00 ± 1.00^{c}	20.0 ± 0.00^{a}

a,b,c: Means within a row with different superscripts are significantly different ($P<0.05$)

CHAPTER FIVE

5.0 DISCUSSION

5.1 Proximate composition of sun-dried cassava peels

The crude protein (CP) content of the sun-dried cassava peel used was (6.56% (Table 4.1). This is slightly higher than the CP values of 4.9%, 4.5%, 5.5% and 2.53% reported by Smith (1992), Onyimonyi and Ugwu (2007), Sogunle *et al.,* (2009) and Abu *et al.,* (2015). The values obtained for the crude fibre (CF) in this study (16.6%) as shown on table 4.1 was smaller than the values reported by Smith (1992), Onyimonyi and Ugwu (2007), Sogunle *et al.,* (2009) and Abu *et al*., (2015). The values of ether extract (8.7%) and ash (6.4%) recorded in this study are higher than the values reported by Smith (1992), Onyimonyi and Ugwu (2007), Sogunle *et al.,* (2009) and Abu *et al.,* (2015). The value of nitrogen free extract (NFE) obtained here is however lower than the values reported by Smith (1992), Onyimonyi and Ugwu (2007), Sogunle *et al.,* (2007) and Abu *et al.,* (2015). The variations in the nutrients may be attributed to the age of harvesting, climate conditions, agronomic practices as well as methods of processing and analysis.

5.2 Body weight

The mean final body weight, mean body weight gain, mean daily weight gain, mean cassava peel intake and mean daily cassava peel intake increased linearly with increasing levels of sun-dried cassava peels. This observation is in agreement with Adegbole *et al.,* (1988) who reported no growth depression in their works. In agreement with this observation also are Fumunyan and Maffeja (1987).

However, this report is in disagreement with the works of Adebowale (1981). The lack of agreement in this study may be because he used maize in the supplement and sheep utilize maize better than cassava peels. Walker (1985) reported poor response when he fed sheep with cassava peels.

The efficiency of cassava peel utilization in this study ranged from 9.4 – 11.1. The efficiency of the feed decreased linearly with increasing dietary levels of cassava peels. This report is in conformity with the ranges of 8.7 – 10.5 reported by Adegbola *et al.,* (1988), Fawole (1980), Adebowale (1981) Adeyanju and Pido (1998), Sowardi (1975) Lakpini *et al.,* (1997).

5.3 Body weight during pregnancy and post partum period

There was no significant difference ($P>0.05$) between the supplement levels on body weight during pregnancy. This showed that cassava peels taken by the ewes during pregnancy was sufficient for maintenance and for production. Though there was no statistical difference between the levels, 6% supplement had the highest value (17.42 ± 1.01). The increase in the dam's

weight in all supplement levels could be attributed to pregnancy due to fetal products (fetus, uterine wall, placenta, fluid etc). This observation was also reported by McCann (undated), Ososanya *et al.,* (2007), Orr and Treacher (1989).

The range of ewe live – weight gain to lambing were 3.67 ± 0.17 – 5.42 ± 0.15. The values obtained here were similar to those values reported by Ososanya *et al.,* (2007) and Bratte (2015).

The mean daily body weight recorded in this study ranged from 0.04 ± 0.00 – 0.06 ± 0.00. The values obtained here were lower than the values reported by Fumanyan and Maffeja (1987), Asaolu (1988) and Adegbola *et al.,* (1988).The cause of the lower daily body weight gain could be that Fumanyan and Maffeja (1987) used cotton seed cake as source of protein. Adegbola *et al.,* (1988) used dried poultry manure for additional crude protein while Asaolu (1988) added gliricidia in his study which is rich source of protein

Mean sun-dried cassava peel intake increased linearly with increasing levels of sun-dried cassava peels. This observation is in disagreement with the reports of Lakpini *et al.,* (1997), Adeyanju and Pido (1978), Fawole (1980), Adebowale (1981). However, this work is in line with reports made by Fumunyan and Maffeja (1987), Adegbola *et al.,* (1988).

There were significant ($P<0.05$) differences in the daily cassava peel intake. 6% supplement recorded higher daily intake of 0.40 ± 0.05 kg/day. The

daily intake of cassava peel therefore increased with increasing levels of cassava peel intake. This is in line with the reports of Fumunyan and Maffeja (1987).

The efficiency of cassava peel utilization of 5.7, 7.1 and 7.3 were recorded in this study. Higher efficiency of cassava peel utilization obtained in this study could be due to pregnancy. During pregnancy cassava peel could have served as a useful energy feed for the ewes hence high efficiency of cassava peel utilization. This report is in agreement with the findings of Lakpini *et al.,* (1997). Gestation and lactation usually require a lot of nutrients. It also alters nutrient partitioning and utilization because of series of adaptions in the metabolism of the dam initiated by pregnancy.

There was no significant difference between the feed supplement levels on post partum mean final body weight. 6% supplement level had the highest value (17.58 ± 0.86) and the least value was 2% (15.63 ± 0.84). The nutritional requirements for lactation and suckling during the post partum period may have limited weight increases as the amount of supplement provided was not calculated to allow for these two processes (Fasanya *et al.,* 1992). Some physiological post partum changes like uterine involution may reduce the weight of the uterus.

There were significant ($P<0.05$) differences in the live weight gains of the ewes during the post partum period. The mean body weight gain increased with increasing levels of cassava peel intake ranging from 1.23 ± 0.11 to 1.95 ± 0.20 kg. This study is in conformity with the reports of Fumunya and Maffeja (1987),

Adegbola *et al.,* (1988). It is in disagreement with the works of Adebowale (1981) who observed depressed growth rate of animal

The daily body weight gain also increased with increasing levels of cassava peel intake. Post partum and gestation weights noticed in this study suggest that the West African Dwarf ewes do not put on much weight during the post partum period.

The mean cassava peel intake and mean daily cassava peel intake increased linearly with increasing levels of sun-dried cassava peel. Adegbola *et al.,* (1988), Fumunyan and Maffeja (1987) made similar reports. Adebowale (1981) however reported decreased feed intake as the levels of cassava peel increase

The efficiency of cassava peel utilization ranged from 10.12 – 12.00. The efficiency of cassava peel utilization was higher in the 2% level. The efficiency decreased as the level of cassava peel increased. This study is in agreement with the reports of Adegbola *et al.,* (1988) and Adebowale (1981). The value obtained in this study is higher than the values reported by Adegbola *et al.,* (1988) whose value ranged from 8.7 – 10.5 and Adebowale (1981) whose value ranged from 7.42 – 11.80.

5.4 Estrus duration, estrous cycle length and progesterone concentration

The mean peripheral serum progesterone concentration of non-pregnant ewes obtained from this study ranged from 1.44 ±0.23 to 2.19±0.44ng/ml. This range is lower than the range of 1 to 8ng/ml reported by Malau – Aduli *et al.,*

(2005) in Red Sokoto goats. The observed difference could be the fact that Malau-Aduli *et al.,* (2005) used conventional concentrate supplements which are nutritionally richer than the sun-dried cassava peel. The 1.02 ± 0.11ng/ml observed in 2% however raises objection on the effect of poor nutrition on the neuro-endocrine system (Lamond, 1986, Salisbury *et al.,* 1978, Rhind *et al.,* 1986).

There was significant ($P<0.05$) difference between 6% supplement level and the other levels during pregnancy. Since the peripheral progesterone concentrations differ slightly between the levels, they may be affected by dietary supplementation. This observation is similar to the observation made by Fasanya *et al.,* (1992) with Savanna Brown goat.

Estrus duration obtained in this study ranged from 24.33 ± 0.21 – 26.17 ± 0.54 hrs. This range is lower than the result of 33hrs obtained in West African Dwarf sheep by Ngere *et al.,* (1999), Adu (1972) and Dettmers *et al.,* (1976). The variation in the hours here could be due to age. The estrus duration is shorter in young ewes than older animals (Girma 2005). This result is however in agreement with the reports by Dzulkarmain (2015), Girma, (2005) and Paul (2015).

The estrous cycle lengths obtained in this study ranged from 12 – 20 days. The 12 days reported here fall into short estrous cycle (Garci *et al.,* 1989, Oyedipe *et al.,* 1986, Emady *et al.,* 2006). The 12 days reported here is however longer than 8 days reported by Emady *et al.,* (2006), 11 days reported by Ijabo

et al., (2014). The 17 – 20 days classified by Emady *et al.,* (2006) as normal cycles recorded in 0, 4 and 6% in this study is in agreement with the reports of Ngere *et al.,* (1979), Adu, (1972), Dettmer *et al.,* (1976), Hafez and Hafez (2000), Pineda (2003). Estrous cycle of 25 days in one of the Yankasa ewes reported by Ijabo *et al.,* (2014) and 36 days reported in Abadeh does by Emady *et al.,* (2006) were however longer than the values observed in this study.

5.5 Reproductive parameters

Though there was no statistical difference ($p > 0.05$) between the levels on pregnancy duration, the shortest gestation length (150.17±0.30) was observed in 6% supplement while the longest gestation length (154.33±1.20) was observed in 0% level. 6% feed supplement had highest concentration of progesterone and since progesterone is an important reproduction hormone necessary for initiation and maintenance of pregnancy in female animals (Malau – Aduli *et al.,* 2004), the pregnancy was maintained and that could be the reason it had the shortest gestation length (150.17±0.30).

The range of gestation length (150.17 ± 0.30) to (154.33 ± 1.20) observed in this study is consistent with the ranges reported by Salifu (2014), Obese (1994), Mukasa – Mugerwa *et al.,* (1994), Ibrahim (1998), Jainudeen and Hafez (2000), Senger (2003), Ososanya *et al.,* (2007), White and Termonth (1970) and Uwechue (2000).

The mean lamb birth weight of this study ranged from 0.97 ± 0.04 to 1.42 ± 0.03. The values obtained in this study were lower than the values reported for Djallonke (WAD) by Tua and Baah (1985), Obese (1994), Salifa (2014). Bratte (2015), Odubote (1992), Fadare (2015). The lamb birth weight in this study could have been affected by the level of nutrition (Bratte, 2015).

All the ewes in the study gave birth to single lambs. The result agrees with the reports of Tua and Baah (1985), Hoque *et al.,* (2002) and Hanford *et al.,* (2006) who stated that nulliparous ewes are known to have a low prolificacy at their first parturition, with the fecundity increasing with parity, depending of course on the ovulation rate of the breed.

All the ewes in this study gave birth to single lambs (100:0). This is in agreement with the reports of Salifu (2014). Values obtained in this study were not in agreement with the reports of Uwechue (2000) and Ngere *et al.,* (1979) (20 – 87%), Dettmers *et al.,* (1976) of 55%, Ososanya *et al.,* (2007) of 75.25, Bratte (2015) of 84 and 16%.

Ratio of M:F lambs was 33.33:66.7 (0%), 33.3:66.7 (2%), 33:3:66.7 (4%) and 16.7:83.3 (6%). The 6% feed supplement had the highest number of females produced than the males in this study. This ratio departed significantly from the expected theoretical sex ratio of 50:50 which Obese (1994) made similar publication on sheep. This report is also a departure from the reports of Ososanya *et al.,* (2007), Salifu (2014) who produced more males than the females.

There was no mortality or abortion recorded in this study throughout the period of the experiment. This is in agreement with the reports of Lakpini *et al*., (1997) and Ososanya *et al.,* (2007).

5.6 Post partum return to estrus and post partum estrous cycle length

There was no significant (P>0.05) difference between the supplement levels on post partum return to estrus but 0% supplement recorded the longest days (9.00 ± 5.00). The longest days observed in 0% level is in line with the reports of Rhind *et al.,* (1989), Wade and Schneider (1992) who reported that energy status is considered to be the major nutritional factor that influences reproductive process, with prolonged low energy intake impairing fertility. Kawu *et al.,* (2007) reported 5 days post partum return to estrus in Red Sokoto doe while Ijabo *et al.,* (2014) reported 21 days in Yankasa ewe. Fasanya *et al.,* (1992) reported 48 days in Savana Brown goats. Resumption of ovarian cyclicity is of economic importance in the sheep production. A prolonged post partum return to estrus results in reduced reproductive efficiency in sheep (Fray *et al.,*1995) and has been identified as a source of economic loss (Yavas and Walton, 2000).

There was significant (P<0.05) difference between the levels on post partum estrous cycle length. 6% supplement level exhibited normal estrous cycle length while 4, 2 and 0% showed short estrous cycle length. This result indicated that resumption of full post partum ovarian activity is often preceded by silent ovulations and irregular estrous cycle. This report is in agreement with

the report made by Noakes *et al.,* (2001) that first post partum estrous is generally short and anovulatory and that the first post partum ovulation are not usually associated with overt estrus. Mukasa – Mugerwa and Zere (1991) reported silent ovulations on 66% ewes returning to ovarian cyclical activities after parturition. Mbayahaga *et al.,* (1998) reported silent ovulation through the progesterone profile on Burundian ewes while Edey *et al.,* (1978) and Bartlawski (1999) reported that silent ovulations are characteristized by the presence of ovarian follicles that luteinized and attained progesterone ability without ovulation. Emady *et al.,* (2006). Ijabo *et al.,* (2014) and Kawu *et al.,* (2007) reported short estrous lengths which were within the range reported here.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

1. Supplementation of grazing West African Dwarf sheep with sun-dried cassava peels at 6% average body weight of supplement significantly increased the body weight of the sheep before conception, during pregnancy and post partum.
2. The supplement at 6% level also improved reproductive parameters of the sheep in terms of (a) enhanced estrus duration, (b) estrous cycle length for nulliparous sheep and progesterone concentration for the non-pregnant and pregnant animals, (c) reduced length of pregnancy and enhancement of post partum return to normal estrous cycle length of 20 days, (d) increased lamb weight.
3. 6% sun-dried cassava peel is safe as supplement for sheep as there was no mortality recorded in the study.

6.2 RECOMMENDATIONS

1. Supplementation of grazing with 6% body weight of sun-dried cassava peel is recommended for sheep.

2. Small ruminant farmers are encouraged to properly sundry the peels before use to avoid possible cyanide poisoning.
3. Further investigation on the maximum percent of sun-dried cassava peel for maximum productivity is also recommended.

6.3 CONTRIBUTION TO KNOWLEDGE

i. Sun-dried cassava peel can be used as supplement to improve the growth and reproductive performance of sheep.
ii. Sun-dried cassava peel if properly cured is non-toxic to sheep at 6% of its live body weight

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