POULTRY MANURE AS SUPPLEMENT FOR CATTLE GRAZING NATURAL PASTURES

BY

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DECLARATION.

I hereby declare that the whole of the work submitted as thesis for the Master of Science degree (Animal science) to Ahmadu Bello University is the result of my original investigations with references to relevant publications which are duly acknowledged and have not been used in any presentation for any other qualification

24th July 1995

C E R T T I F I C A T I O N

This Thesis "Evaluation of poultry manure as supplement for cattle grazing natural pastures" by Owolabi Saka Lamidi meets the guidelines stipulated for the award of Master of Science (M.Sc.) of Ahmadu Bello University and is certified for its contribution to scientific knowledge and literary presentation.

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DEDICATION

This thesis is dedicated to my son Master Farouq Abiodun Olasunkanmi Hameed, my beloved wife, Kudirat Abiola Lamidi, my dear mother Alhaja Asaiwu Oyepeola Lamidi and finally to the memory of my father Alhaji Lamidi Otoyebi .

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TABLE OF CONTENT

Title page ... i

Declaration ... ii

Certification ... iii

Dedication ... iv

Aknowledgement ... v

Table of content ... vi

List of tables ... viii

Abstract ... ix

Chapter 1 ... 1

Introduction ... 1

Chapter 2.0 ... 3

Literature review ... 3

2.0. Ruminant feed resource of Nigeria ... 3

2.1. Range Resources ... 3

2.2. Crop Residues ... 6

2.3. Supplementary feed ... 9

2.4. Browse Plant ... 13

2.5. Need for non conventional feedstuff ... 15

2.6.0. Poultry manure ... 16

2.6.1. Chemical composition of poultry manure ... 17

2.6.1.1. Nitrogen content of poultry manure ... 17

2.6.1.2. Energy content of poultry manure ... 18

2.6.1.3. Mineral composition of poultry manure ... 19

2.6.1.4. Fibre content of poultry manure ... 19

2.6.2.Nutritive value of poultry manure ... 20

2.6.3.Microbiology content of poultry manure and
methods of disinfecting the manure ---- 23
2.6.4.Gases and chemicals in poultry manure and
their effect on the quality of animal product- --25
2.6.5.Effect of processing on the quality of poultry
manure ---- 26
CHAPTER THREE---- 30
3.0. Materials and Methods ---- 30
3.1 Experiment 1. Nutrient composition of
poultry manure ---- 30
3.2 Experiment 2.growth trials with experimental
containing poultry manure ---- 32
3.2.1. Trial 1.- ---- 32
3.2.2. Trial2.- ---- 35
CHAPTER FOUR ---- 39
4.0. Results and Discussion ---- 39
4.1. Results ---- 39
4.2. Discussion ---- 49
CHAPTER FIVE ---- 55
5.0. References ---- 55

LIST OF TABLES. PAGE

Table 1: Rainfall (mm) summary during the two years (1991 and 1992) grazing trial. 38.

Table 2: Chemical composition (%DM) of sun-dried poultry manure.(SDPM) 40.

Table 3a: Chemical composition of the supplements fed to the bulls during the first (1991) grazing trial. 41.

Table 3b: Chemical composition of the supplements fed to the bulls during the second (1992) grazing trial. 41.

Table 4: Supplement intake, rumen ammonia concentration and live-weight gains of bulls grazing natural pastures and receiving supplements containing sun dried layer manure (SDLM) and cotton seed cake(CSC). 43

Table 5: Supplement intake, rumen ammonia concentrations and live-weight gains of bulls grazing natural pastures and receiving supplements containing sun-dried broiler manure (SDBM) and cotton seed cake (CSC). 46

Table 6: Serum Calcium, Magnesium and Phosphorus concentrations (mg\100ml) sampled at three different stages from bulls grazing natural pastures and receiving supplements containing SDBM and CSC. 47

List of tables page

Table 7. Effect of time of sampling on the serum Calcium, Magnesium and Phosphorus concentrations (meq\100ml) of bull's grazing natural pastures and receiving supplements containing 30GM and 60GM. 40

ABSTRACT

Three studies were carried out in 1991 and 1992 to evaluate the nutrient composition and feeding value of poultry manure. In the first experiment, layer, broiler, cockerel and pullet manure were collected from nine farms in and around Zaria and was evaluated for their nutrient composition.

In the second trial, twenty-eight Fulani x Sokoto crossbred bulls, weighing between 90 - 160 kg were blocked by weight and randomly allotted to seven supplementary feeding treatments and used to study the replacement value of sun-dried layer manure (SDLM) for cotton seed cake (CSC). Sun dried layer manure replaced CSC at 0, 20, 40, 60, 80, and 100% weight for weight in the supplements. The last group which did not receive any supplement served as the control. The supplements were fed at 1% of the estimated daily dry matter (DM) intake to each bull in the morning before they were grazed on the range. The trial took place during the 1991 wet season and lasted for 112 days.

In the third trial, twenty-four bulls with average group weight of 117 ± 6.0kg, were allotted to four treatments in which sun dried broiler manure (SDBM) replaced 25, 50 and 75% CSC. The last group which served as the control was not supplemented. The supplements were fed at 1% of the estimated DM intake to each of the bulls in the morning before grazing on the range. The study took place

during the 1992 wet season and lasted for 98 days.

Results of the chemical composition showed that, the average crude protein (CP) content of broiler manure was higher than those of layer, cock and pullet manure ($P<0.05$). The ash content of all the manure tested was higher than what is found in most feedstuff, but their gross energy was low and showed an inverse relationship with the ash content. Calcium, phosphorus and magnesium contents of layer manure was higher than those of broilers, cockerel and pullet manure. In general, the mineral content of the manure are higher than most feedstuff. The ADF and the NDF of all the manure tested ranged between 19.40 - 22.45 and 22.45 - 44.47% respectively.

In the second experiment, increasing the level of the SDLM in the supplement significantly ($P<0.05$) reduced consumption of the supplements. Rumen ammonia concentration on the average was between 10.89 and 9.45 mg/100ml for the supplemented and the control group respectively. Increasing the level of SDLM in the supplement did not affect the rumen ammonia concentration ($P>0.05$). Increasing the level of SDLM in the supplement up to 60% replacement did not affect ($P>0.05$) average liveweight gain of the bulls, but further increase in the proportions of SDLM in the supplement significantly lowered ($P<0.05$) the weight response of the bulls.

In the third experiment, consumption of the supplements

CHAPTER ONE

1.0 INTRODUCTION.

Rangeland is and will for a long time to come be the main source of feed for ruminants in Nigeria. The productivity of the range has been reviewed by some workers (Blair Rains 1963, de Leeuw 1971, Umunna and Agishi 1988, Kapu, 1985). de Leeuw (1971) reported that cattle grazing on the range could only gain up to 50kg per annum. The same study also revealed that up to 20% of the weight attained during the wet season are lost before the end of the dry season. In another study Zemmelink, (1974), reported that about 300-400 g/day of weight are lost during the dry season in cattle grazing upland savanna without supplement. This is responsible for the late attainment of reproductive activities and low market weight exhibited by indigenous cattle grazing natural pastures.

From available information (de Leeuw and Brinckman,1974 .,ILCA,1979) it is understood that cattle and other ruminants grazing natural range without any form of supplementation might not be getting enough protein, energy and minerals for growth hence their slow growth rate. It is therefore important to provide supplementary feed in form of protein,energy and minerals to augument the deficiencies in the natural forage.

The conventional protein sources used as supplement for ruminant in Nigeria are the oil seed cakes (cotton seed cakes, soybean cake and groundnut cake). The high cost of

these protein sources and their scarcity limit their use in ruminant feeding. The use of urea and other non-protein nitrogen compounds has received some attention. Utilization of urea requires more energy than is found in most tropical forages (Bloomfield *et al.*, 1964). Molasses which is commonly used as an energy source in a urea/molasses supplementary diet is presently unavailable because of its alternative uses as raw material in the alcohol distilling industries. Also the increase in the level of cropping activities has made urea less available for ruminant feeding. There is also some hazard associated with the feeding of urea which limits its wide spread use. Therefore, there is a need to identify cheaper and safer source of protein supplements for ruminants. Other available non-conventional protein sources for ruminants are the leguminous crop residues which already exist within the farming systems, the leguminous trees such as Leuceana leucocephala, Gliricidia sepium can be used as farm hedges, life fence and alleys which can be pruned and fed to ruminants.

Dried poultry manure (DPM) has been used as a nitrogen source in ruminant diets containing moderate to high energy levels (EL-Sabban *et al.*, 1970; Smith and Calvert, 1976). It is less harmful,inexpensive and available.

The projected population of chicken in Nigeria according to the report of the Presidential task force on alternative formulation of livestock feeds stood at 90.55

million as at 1993. The quantity of droppings produced by a chicken varies with age, type, sex and health status. But in general, the exotic chicken produces more manure than the indigenous. It was reported that an exotic bird produced between 63-70kg droppings per year (Oluyemi and Robbert 1979). The large poultry farms in Nigeria especially around the urban centres, produce large quantities of droppings. This can result in environmental pollution if not properly disposed off. A useful way of disposing poultry manure is to feed it as a supplement to ruminants. Dry poultry manure is mainly used as an organic manure in Nigeria , but it can also be used for feeding sheep, goats, cattle and pigs. Information on the feeding of DPM are scanty in Nigeria and no information is available on the use of DPM as supplements for cattle grazing natural pasture . Martin (1983) in his work reported that the monetary value of DPM is higher as ruminant feed than as a manure. Therefore, feeding DPM to cattle or other ruminants will serve as an economic way of disposing the waste and will go a long way to address the problem of meat shortage in the country.

The objectives of the present studies are therefore, to determine the effect of feeding DPM on the weight changes of bulls grazing natural pastures during the wet season and to determine the best levels at which the DPM can replace CSC supplement without any detrimental effect on the weight response of the bulls.

CHAPTER TWO

LITERATURE REVIEW

2. RUMINANT FEED RESOURCES OF NIGERIA.

2.1 RANGE RESOURCES.

Rangeland can be defined as an extensive area of land with vegetation consisting of predominantly herbaceous plants suitable for grazing and browsing by livestock and wildlife. Rangeland is highly diversified and includes natural grass lands, meadows, savannas, brushlands, semi-deserts and deserts. Range may be treeless or consist of under storey vegetation beneath open forest.

The quality of forage available for free grazing herbivores on rangeland depends on the area of the range,the level of tsetse infestation, human population in the area, size of farm lands, mobility of herbivores and location of the rangeland (Milligan and Sule, 1982). de leeuw, (1977) estimated the area of land under natural rangeland in the four rainfall zones in Northern Nigeria to be 90.00, 117.10 177.40 and 120.80 (in 1000Km2) for areas under the rainfall of 500-700, 750- 1000, 1000-1250 and above 1250mm respectively. In addition to rainfall which is the major determinant of herbage yield, yield is also closely related to the catenary sequences of the soil (ILCA, 1979). The herbage yield of natural rangeland is reported to range between 1.5 - 18 T ha^{-1} depending on the local site conditions (Milligan and Sule, 1982), range between 2.0 -

6.0 T ha^{-1} look more logical (ILCA, 1979). The lowest herbage yield from the range occur on shallow gravelly soil with low, and sparse grass cover and the higher yield is associated with deep loamy soil (Milligan and Sule, 1982). Tanko et al.,(1992), reported that Fadama gave higher yield of low quality herbage than the uplands. Proportion of shade (de Leeuw, 1978) and Woody cover (Rose Innes and Mansfield,1976) also reduces rangeland yield . However, the influence of the woody vegetation on species composition of the herb layer may produce the opposite results (Milligan, 1979).

It should be noted that, not all the potential grazing lands in the country is available to livestock because of the risk of trypanosomiasis in areas infested by tsetse. The presence of trypanosomiasis is responsible for the lower concentration of livestock in the humid and sub humid zones and other more restricted areas in the country. During the dry season, the tsetse usually retreat to areas of shade and moisture and thus the cattle that reside in the more Northern sudan zones move into these areas (sub humid zone) in search of suitable grazing and water sources. Some areas within the sub humid zones have been made tsetse free for grazing because of government land clearing and spraying programmes making year round grazing possible. However, such programmes are expensive and there is always the risk of tsetse re-infestation. At present resident cattle are found within

the sub -humid zone near areas that are cleared by farmers and it is likely that the general agricultural expansion will open more land areas for cattle and consequently decrease the actual areas of non farmed rangeland. This is one of the reasons for the establishment of grazing reserves.

Both the quantity and quality of available forage on the range are affected by the season. At the beginning of the wet season, growth of forage is slow and linear. This period is characterized by forage of high quality but low dry matter. This period is followed by stage of stem elongation which occurs in August for short grasses in Northern Nigeria and several weeks later in the Southern part of the country (ILCA. 1979). Tall grasses, mature later than short ones. The CP content of most grasses in northern Nigeria, ranges between 5-9% during the wet season (Blair Rains, 1963 and Haggar, 1970) and falls during the dry season to as low as 2% (Blair Rains,1963; de Leeuw and Brinckman,1974). The CP content of most grasses in northern Nigeria falls below the critical levels required for maintenance by September (Umunna and Agishi, 1988). Coupled with the decline in CP content is the increase in cellulose and lignin content of most forages leading to decrease in digestibility and voluntary intake . The mineral content of the forage have been extensively discussed (Kapu, 1975; Umoh and Koch, 1971; Brinckman and de Leeuw, 1979). Calcium, magnesium, potassium and phosphorus levels reported by these authors showed that although, the

minerals content of grasses are lower than those of browse plants, they appear to be adequate for maintenance of cattle except for Phosphorus which is as a result of the low level of this mineral in soils of Northern Nigeria (Adegbola,1979).

The phosphorus level of most grasses varies between 0.0437 - 0.2185 % of DM in the rangeland, but under natural condition, it is higher than 0.1311 % DM. This level is below the 0.144% DM of P required for maintenance of cattle, (Milligan and Sule, 1982). Calcium is higher and less variable in the rangeland with values ranging between 0.60 - 0.80 % DM (Milligan and Sule,1982) while magnesium levels in most grasses are enough to meet the requirement of cattle grazing the range,(Tanko *et al*., 1992).

Studies on the carrying capacity of natural grassland from different ecological zones of Nigeria show that a high variation from 14 ha/ TLU in Sahel (de Leeuw and Brinckman, 1974) to as high as 4 ha/TLU in the derived savanna (Adegbola and Onayinka, 1968). The carrying capacity of the range is reported to be related to the amount of rainfall in an area and this decreased from the forest to the sahelian zone of the country (Blair Rains and Kassam,1980). Ory matter yield and digestible nutrient obtained from different zones are related to the carrying capacity. Productivity of animals on the range also varies depending on the zone. In the Sahel zone, de-Leeuw and Brinckman,(1974), reported that cattle rarely gain more than 50kg per annum even when supplemented,

whereas in Fashola, Adegbola and Onayinka, (1968), reported a gain of 115 kg per annum. It would appear that the nutritional value of natural rangeland even under the conditions of plant selection is inadequate to support large herbivores on a year round basis. The low quality of available forage may be the most important constraint to livestock production under the Nigeria savanna conditions, (ILCA, 1979). Although, a variety of approaches have been proposed, their acceptability and cost/benefit within the traditional management systems have yet to be tested.

2.2 Crop Residue.

Crop residues constitute an important feed resource for ruminants during the dry seasons (Umunna and Agishi, 1988; Van raay and de leeuw, 1970). Vast quantities of these materials are available in the traditional home of ruminants in Nigeria (i.e. Sudan-Sahelian zones). From seeds extraction rate, Alhassan,(1985) estimated the total crop residues in the country to be 50 million metric tons per annum. The quality of these residues varies greatly and is affected by the types of crop, types of fertilizer and rate of fertilization, morphological composition ,types of cultivar, genetic characteristic,storage systems (Pearce,1983), and date of maturity (Alhassan, *et al.*,1987). The nutritive value of cereal intercropped with legumes are generally higher than sole cereal crop field (Yayock and Owonubi, 1986).

The major limitations to the use of crop residue as

ruminant feed is its coarse texture, low protein and mineral content and High lignocellulosic materials . This is particularly true of the cereal crop residue (Umunna and Agishi,1988), resulting in low intake, low digestibility and consequently low animal performance.

Unlike the cereal residues ,the leguminous crop residue are relatively higher in CP and mineral content even at maturity (Agishi, 1971), but their conservation in form of hay could be difficult due to leaf shattering. Despite the low nutritive value of crop residues , Powell and Mohammed Saleem, (1987), reported that the CP , digestible crude protein and organic matter of crop residues were higher than those of range forages at any time of the year because of fertilizer applied to the crops.

2.3 SUPPLEMENTARY FEEDS

The supplementary feeds available to ruminants can be categorised into three major groups.

i. The by-products of high energy sources

ii. The by-products of both energy and protein sources

iii. The by-products of protein sources

i. The by-products of high energy sources

These by-products are rich in fermentable carbohydrate but low in nitrogen. They can be used as substrate for the synthesis of microbial protein. The by-products that fall into this category are the oils, fats, liquid feeds (molasses) and fruit cannery by-products.

Molasses: Production of molasses in Nigeria declined from 92,000 metric tons (Adebgola,1977) to 16,000 metric ton (Barreveld,1982) from 1977 to 1981. The level reported during 1977 was said to be the lowest of all sugar cane producing countries in West Africa (Barreveld,,1982). High level of molasses feeding in the absence of other fermentable carbohydrate leads to low levels of propionic acid and more butyric acid production (Clark, *et al*; 1972), resulting in lower animal production. Molasses can be fed to cattle as a lick, sprayed or poured over other feedstuff,mixed with prepared feed or diluted with water and offered as main source of free water (Umoh,1982). The major constraints to molasses feeding is its alternative uses in the breweries industries resulting in scarcity as ruminant feed. In addition, the high cost of transporting the by-product makes it largely unaffordable by smallholder farmers.

Other available energy sources in the country are the peels of cassava and yam, oil slurry and cannery by-products. Most work on the use of peels is limited to small ruminants. Otchere, *et al.*, (1977), reported improvements in the growth of West African dwarf goats fed urea-molasses supplements containing 28% cassava peel as compared with those fed rice straw. Large scale feeding of the peels even to the small ruminants is hampered by its availability.

Oil slurry: It is a major pollutant in the palm oil producing areas. Presently there are very few studies on the

utilization of the slurry by cattle. The high water content of the slurry renders it too bulky to be transported to areas where ruminants are abundant. Its uses are therefore, site specific.

The fruit and cannery by-products have limited use in Nigeria due to problems of availability and fermentation problems in storage. Like the oil slurry it is also site specific.

ii. By-products of both energy and protein sources:

These by-products include grain by-products (i.e. Products of flour milling). The composition and usefulness depends on the milling efficiency and level of husk present. The by-products included in these category are:-

Wheat bran: The bran contains most of the vitamins and protein of the grain. It is a bulky feed that can be used to lighten dense and heavy feed mixture. It has a slight laxative effect because its fibre is only modestly digested. Ban on the importation of wheat has led to a decline in the production of the offal. Insufficiency in collection, storage and distribution have resulted in high wastage and lowered the level of utilization of the offal. Furthermore, the incorporation of the offal in the diets of poultry and other monogastrics, has made it less available and expensive as ruminants feedstuff.

Brewers wet grains (BWG): This is a by-product of the breweries industries. It is low in energy (Umoh,1982). high

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in crude fibre (31%DM) and NDF (71%DM) (Alhassan,1985) and moderately high in crude protein (22%DM). Up to 12kg/head have been used for cattle below 500kg (Gohl,1975). The major constraint to the use of BWG in ruminants feeding apart from its competitive use as monogastric feedstuff is the lack of economic drying facilities in the breweries which has resulted in high cost of the product due to the heavy cost of transporting the wet product. The ban on the importation of malt in the country has led to considerable decline in the production of BWG , resulting in further increase in the cost.

Rice bran: It is fairly palatable to farm Animals and it is a good source of B-vitamins.It contains about 10-15% crude fibre (Umoh,1982). The bran is best preserved by heating or drying immediately after milling. Because of the poor feed value of the bran ,large quantity of it is usually wasted or burut around rice mills.

iii. By-products of protein sources.

The most important agro industrial by-product used as protein supplements are the oil seed cakes, Cotton seed cake (CSC), Groundnut cake (GNC), Palm kernel cake (PKC). Undilinted and undicorticated CSC is the most widely used oilseed cake for ruminants feeding in Nigeria due to its availability and lower cost compared to groundnut cake (GNC). The declining productivity of cotton in Nigeria in the recent years has affected the availability of CSC in Nigeria. Also

the incorporation of the CSC in the diet of monogastrics has further increased its cost beyond the reach of farmers.

Palm kernel meal: It is fibrous, less palatable, gritty and has lower protein content (14-16%) than GNC and CSC. The degradability of the protein in the rumen is reported to be low (ARC,1980). Although, PKM is cheaper than CSC, the cost of transporting it from the Southern part of the country where it is produced to the North where most ruminants are found makes it more expensive.

Copra cake: This is a by-product of coconut oil extraction. It is less fibrous than PKM and has slightly more protein (24.4%) and more palatable . But it is less available due to low production.

Soyabean cake and sunflower cake: These are more nutritious with CP contents of 50% and 31% respectively. They are very expensive such that their inclusion in the diets of ruminants may not be economical.

2.4 Browse plants.

Browse plants play an important role in the nutrition of ruminants especially during the dry season when the quality of forages is low. The list of browse plants available in Nigeria was given by Saleem *et al.*,(1979) for sudan savanna zone of North Western Nigeria and Mecha and Adegbola, (1980) for southern Nigeria. Most research work on browses in Nigeria is limited to *Leucaena leucocephala and Gliricidia sepium* and recently Ficus spp. and are concentrated on small

ruminants with little or no work on cattle.

Productivity of browses depends on the species, ecological zones and types of management adopted. The productivity of the browses is difficult to know because of the difficulty in measuring the primary product (Adegbola, 1977). However, the productivity of browses in a plantation is higher due to better soil preparation and management practices. The productivity can also be measured with a good degree of accuracy.

There is abundant information on the chemical composition of browses found in the South Western Nigeria (Carew *et al.*,1980), North Western Nigeria (Saleem *et al.*,1979) and South Eastern Nigeria (Mecha and Adegbola, 1980). The CP content of heavily browsed species ranges from 12.3 to 21.8%, and for moderately browsed species the CP ranges from 5.3 to 15.6% (Saleem et al., 1979). Browses tress and shrubs have on the average higher CP and minerals than the grasses at any time of the year (Adegbola,1985). The crude fibre and ether extract of the browse is lower than grasses harvested at the same time (Mecha and Adegbola, 1980). Browses like Leucaena luecocephala and Ficus spp. have enough energy to meet the requirement at maintenance and above (Adegbola,1985).

The major limitations to the use of some browses apart from the those of establishment,management and biological productivity are the presence of some anti nutritional

compounds which affect the nutritive value of the forage as well as the animal feeding on the browse. Some of the anti nutritional compounds found in browses includes mimosine, tannins ,oxalates, condensed tannin, nitrates which are found in various part of the plants .

2.5 Need for Non-conventional feedstuff.

From the above review, it is evidently clear that the range resources cannot adequately support high animal productivity. There is therefore a need to provide additional nutrients in form of supplements to the animals in order to improve the productivity of grazing stock. The most direct and quickest method of improving the utilization of available forages is by feeding high quality agro -industrial by-products. The cost and logistic implications of these method are very high. Various types of plant introduction particularly legumes, would seem promising . though, the actual methods of such introduction within the social situation of traditional pastoralism need to be carefully considered. An introduction into fallow and by undersowing presently cultivated land may be more practical and benefit Fulani pastoralists more than mass bush clearing and pasture development. A better management of the present rangeland using controlled burning and rotational grazing practices, would involve the least cost but would be difficult to implement and control on a large scale. The most visible strategy of improving the productivity of ruminants grazing

the rangeland would be through protein supplementation (Winter, 1991), since the CP content of feed is closely related to other parameters of nutritive value and has been shown to have an overriding influence on animal performance, (Zemmelink, 1974). Considering the high cost of conventional protein sources, the search for non-conventional, cheaper and non competitive sources of protein therefore, become necessary. Some of non-conventional feeds being evaluated are:- Poultry manure, blood meal, cassava and yam peels etc. The thrust of this work is on dried poultry manure.

2.6 POULTRY MANURE

Poultry manure is traditionally used as organic manure in Nigeria. It is also used as feed for sheep, goats, cattle and pigs, but this has not been adequately quantified. It has been used as a nitrogen source for ruminants in other countries (Tagari, 1962, in Isreal, El-Sabban et al., 1970 , in the United states). It is capable of supplying the rumer microbes nitrogen necessary for rumen bacterial synthesis (Bela 1954, Jurtshuk *et al.*, 1955). Poultry droppings is a chea source of nitrogen compared to urea and can be fed with forages of medium to high energy content. Nitrogen in the droppings is ten times more efficiently utilized when fed to ruminants than when used as manure for growing crop (Smith and Wheeler, 1979), and in monetary terms, the value of the droppi as ruminant feed exceeds that of manure (Martin *et al.*, 1983).

There are generally two types of poultry droppings.

These are the caged layer droppings which in addition to the droppings, contains varying proportions of spilled chicken feed, egg content and shell and feather all contributing to the feeding value of the dropping. The other type,deep litter manure, contains litter materials in addition to spilled feed, feather and droppings from either layers or broilers in deep litter houses. These two types of poultry droppings are referred to as layer or broiler manure in the present study.

2.6.1. Chemical Composition of Poultry manure.

Generally, there are variations in the nutrient composition of poultry manure. The major variations exist in the crude protein content, which depends on factors such as composition of the diet, the physiological state of the birds, drying temperature , duration of storage of the wet material and type of litter (Polin *et al.*, 1971 ., Smith, 1974).

2.6.1.1. Nitrogen content of poultry manure

Various workers have reported different figures as the N content of poultry manure. Bhattacharya and Fontenot (1966) and Polin *et al.*, (1971) reported 4.80% on the average. Smith (1974) reported that the CP content of poultry manure depended on the CP content of the diet of the birds. He found that birds consuming diets containing 2.56% N (layer mash) and 3.20%N (broiler mash) produced droppings containing 4.48 - 5.76% N and 6.08 - 6.40 % N respectively. EL-Sabban et al

.. (1970) . reported 3.2 % and 4.48 % N for layers and broiler manure respectively. About 30 - 50 % of the reported CP content of poultry manure is true protein (Bhattacharya and Fontenot, 1966), but Polin, *et al.*, (1971) reported a lower value of 11% . The true protein content of poultry manure contains at least sixteen different amino acids (Belasco, 1954. Evan, *et al.*, 1975 and Flegal and Zindel, 1971). Poultry manure is rich in glycine and cystine but low in arginine, lysine and very low in methionine (Flegal and Zindel, 1971). The major non-protein nitrogen compound in poultry manure is chiefly uric acid (C^2 H^2 N^4 O^3) which, according to Bhattacharya, (1964) and Morgan (1970) accounts for about 30-60% of the total nitrogen. Uric acid when compared to urea is less soluble in water and more slowly available to the rumen microbes and therefore, subject to less loss through ammonia production by direct absorption.

2.6.1.2. Energy content of Poultry manure.

The energy content of poultry manure is generally low, (Lowman and Knight, 1971). This is attributed to the high ash content of the manure. Dry poultry manure has a digestible energy value of 2.0 Mcal/kg for sheep and cattle, making it approximately equivalent to a good quality hay (Bull and Reid, 1971). Bhattarcharya and Fontenot, (1966) reported 2.44 Mcal/kg digestive energy for broiler manure in sheep, this value compared favourably with the 2.48Mcal/kg for alfalfa hay. The type of litter material used had no

effect on the energy value (Bhattacharya and fontenot, 1966). However, in another study in which the manure contained citrus pulp as the litter, Malik and Bhattacharya, (1971) reported a significant increase in the digestible and metabolizable energy.

2.6.1.3. Mineral Composition of Poultry manure.

Layer manure has a high ash content of 28% (Bull and Reid, 1971 and Polin *et al.*, 1971) which lowers its energy content. The ash content of broiler manure is about 15% and compares well with most natural foodstuffs (EL-Sabban et al ., 1969). The calcium and phosphorus contents of layer manure are 5.7% and 2.5% and those of broiler manure are 1.7% and 1.5% respectively, (EL- Sabban *et al.*, 1969 and Polin et al., 1971). When poultry waste was used as the sole protein source, the calcium and phosphorus was 97 and 75 percent available (Bull and Reid, 1971). EL-Sabban *et al.*, (1969) reported the sodium and copper contents of the manure to be 0.54% and 0.94ppm respectively. A higher value for copper, 150ppm (Hodgette, 1971) have also been reported.

2.6.1.4. Fibre content of poultry manure.

The layer manure has a lower crude fibre content than the broiler manure, this is associated with the litter materials which are mostly fibrous materials. The crude fibre content of layer waste is about 12% (Polin *et. al.*, 1971 and Long *et. al.*, 1969) while that of broiler waste is 16% (Bhattacharya and Fontenot, 1966)

2.6.2. Nutritive value of poultry manure

Intake of dried poultry manure is usually low at the start of a feeding trial, but improves with time (Abu-Izzedin and Bhattacharya, 1969). Molasses could be added when available to improve palatability and up to 10% inclusion of unprocessed broiler manure was found not to have any effect on intake (Bhattacharya *et. al.*, 1971, and Harmon *et. al.*, (1975). Crude protein digestibility of layer manure when fed as sole (90%) protein source is about 53% (Tinnimit *et al.*, 1972), a higher value of 77% was reported by Lowman and Knight (1970) and Brugman *et al.*, (1964) using sheep. However, Smith and Calvert, (1976) observed no differences in dry matter and CP digestibility when poultry manure replaced soybean meal at 0,50 and 100% in sheep.

In another study in which broiler manure constituted 50% of the ration of sheep, Bhattacharya and Fontenot, (1960) and McInnes *et al.*, (1968) gave the digestibility value as 70%. In a sole broiler manure ration, the digestibility was 77-82% for sheep (Jeroch *et al.*, 1969). In a practical ration fed to cattle, the overall digestibility of organic matter declined at an exponential rate from 76 to 67 % when the level of DPM incorporated increased from 20 to 80 % , even though the feed intake of all the ration remained the same (Tinnimit *et al* .,1972)

The amount of nitrogen retained is affected by the quantity of poultry manure fed. In an experiment with

sheep, no difference was observed in nitrogen retained when the manure contributed up to 50% of the purified diet (Bhattacharya and Fontenot 1960). On the contrary, Ammerman *et al.*,(1969) reported a marked change in nitrogen retained when the manure constituted up to 65% of sheep ration compared to soybean basal diet.

In a study in which poultry manure replaced 55% of equal amounts of a mixture of barley, oil cake and wheat bran in cattle fattening ration, live weight gains were 78% more than the control group (Rodrigues and Zorita 1967).

In another study, Denison *et al.*, (1973) observed an improvement in daily weight gains in cattle fed ration in which 25% of the sunflower meal was replaced by 21% poultry manure. Smith (1974) and Cooper *et al.*, (1974) observed no differences in dry matter intake, average daily gain, feed efficiency and nutrient utilization in a corn meal containing either 12.8% CSC or 20.5% dried poultry manure. Contrary to the above observations, Bucholtz *et. al.*, (1971) reported a depression in daily gains of steer fed diet containing 32% dried poultry manure and he attributed this to inadequate consumption of the layer manure used in the study . A similar observation was also made by Westhuizen, *et al.*, (1972). Inclusion of broiler manure at 25% of soybean meal did not have any significant reduction in daily gains. In a trial conducted by Smith (1974), inclusion of broiler manure resulted in daily weight gains of 0.64kg in cattle fed rice

bran and straw as compared to 0.45kg for those without broiler manure. In another study Muftic *et al.*,(1969) reported a higher daily gains of 1.2kg when cattle ration was replaced at 40% broiler manure, Bastman, (1973), however, observed no difference in daily gains of beef cattle when poultry manure was included at 20, 40 and 60%. Cullison *et al.*,(1973), Cooper *et al.*, (1974) observed no difference in the performance of steer fed dried poultry manure at 0, 50 and 100% level. On the contrary, Devisov *et al.*, (1973) reported a decline in daily gain when the level of inclusion exceeded 25%.

Lambs fed poultry manure have also shown an improvement in their performance, (Adu and Lakpini, 1983). McInnes *et al.*,(1968), observed no difference in the performance of merino sheep fed 365g, 235g and 190 g of poultry manure per day. In another study involving six month old Merino sheep ,replacing carob bean in a concentrate mixture at 36% dried poultry manure did not show any difference (Rodrigues and Zorita, 1967). Smith and Calvert (1972) reported no difference in the average daily gains and feed required per unit gain in lambs when dried poultry manure replaced soybean meal at 0, 50 and 100% level even though the performance tended to decline by 9 and 15% respectively at 100% soybean meal replacement. In a more recent work, Adegbola *et al.*,(1990) observed no difference in the average daily gains and feed efficiency in West African Dwarf Sheep fed 55.0g of

feed in which caged hen manure replaced grountnut cake from 0 to 100%.

Milk production is enhanced by feeding poultry manure to animals. Muftic *et al.*,(1969) reported an unexpected increase in milk yield of cows fed 75% broiler manure and 25% ground corn with 2kg hay per day. Ewes seem to respond less to dried poultry manure in terms of milk production (Rodrigues and Zorita, 1967). The quality of milk resulting from feeding dried poultry waste is another major area of concern, but the work of Zindel (1970), Bull and Reid (1971) showed no adverse effect on the quality of milk when dried poultry waste replaced 50% of the concentrate mixture.

2.6.3. Microbiological content of poultry manure and methods of disinfecting the manure.

Poultry manure apart from being a component of feed, is also a potential source of danger to the animal consuming the manure. The manure contains pathogens and residues of drugs used in disease control. Pathogens like parasites, fungi, toxins, bacteria and virus which are capable of causing disease in humans, livestock and poultry have been isolated (U.S.D.A. 1957; Schwade, 1964 and Lovett, 1972). Freshly voided poultry droppings may contain Salmonella, mycobaterium, clostridium, streptocccus, stapylococcus, shigella, listeria , Escherichia Coli, mould, yeast, proteus and coliforms (Kraft *et al.*,1969; Alexandra *et al.*,1968 and Galton *et al.*, 1964). However, Lovett *et al.*,(1971) did not

detect any salmonella in samples taken from four farms in Ohio. The level of microbial content in animal manure depends on factors such as the management systems in the farm. P^H, moisture content and temperature. Length of storage has little influence on the microbial content of the manure (Lovett *et al.*,1971)

Poultry droppings carry human pathogens such as the Newcastle disease, and psittacosis which cause conjunctivitis and pneumonia in humans (Schwade, 1964). The cage layer manure has an offensive odour and is messy to handle, there is therefore the need to carry out some form of processing to reduce or eliminate the bacterial load to a tolerable level as well as to obtain a more stable and odourless material. This will reduce the risk which the animals consuming the manure is exposed to and consequently the final consumer of the animal product. Less risk is expected when manure of one species of animal is fed to another species so the risk in feeding the poultry manure to cattle is less.

Various processing methods have been employed to render poultry manure safe as cattle feed. These methods include oven-drying, ensiling, sun-drying, air-drying, heating, freeze drying paraformaldehyde and ethylene oxide treatments, (Fianu *et. al.*, 1984). Messer *et. al.*, (1971), observed that all the Salmonella and Arizona spp in poultry manure were eliminated when dried at 680C for 30min irrespective of the moisture content.

Alexandra *et al*., (1968) showed that certain seeded potential pathogens survived longer in sterilized droppings than unsterilized ones. According to them, storing the dropping for 1-2 months was adequate in destroying all the salmonella present. In a similar study, droppings stored in a 50 litter drum for 6 days in summer (16-25%) and for 26 days in winter (5-110c) completely destroyed salmonella (Strauch and Muller, 1968).

Sun-drying is the most practical and economically feasible method in Nigeria, considering the high cost of equipments required in other methods. This method (spreading the manure in the sun for 4-5 days) has been successfully used by Adu and Lakpini, (1983) Odhuda (1989) and Adgbola *et al*., (1990). Ensiling poultry manure is another feasible method of eliminating the pathogen through fermentation of soluble sugars by anaerobic microorganisms into acetic and lactic acids. This method has been found to deodorize the manure, impart pleasant aroma and enhance palatability and voluntary intake when poultry manure was used up to 45% of total dry matter of ensiling material (Harmon et al., 1975).

2.6.4. Drugs and chemicals in poultry manure and their effect on the quality of animal products

There are many drugs used for disease control treatment and for the promotion of production. They include antibiotics, coccidiostat, arsenic, hormones and heavy metals. Most of these drugs are present in poultry droppings

at varying proportions. According to USDA (1957), the major concern of the United States Food and Drugs administration regarding recycling of animal waste is the possible danger to the health of the animal and humans consuming the animal products. Drying, autoclaving and ensiling methods have been reported to reduce the drugs in the droppings. (Fontenot 1971). In another study, Fontenot (1972) Brugman *et al.*.(1967) observed that steers fed diet containing 50% dried poultry manure for 121 days had 0.19 and 0.627ppm of arsenic compound in the muscles and liver as compared to the recommended arsenic compound level of 0.5ppm and 2.0ppm for muscles and liver of chicken, when the feed was withdrawn 5 days before slaughter. Arsenic content of milk from cows fed dried poultry manure containing 18 ppm arsenic with daily arsenic intake of 40mg/cow/day showed no increase in arsenic content (Brugman *et al.*, 1967).

Antibiotics: Antibiotics that may legally be fed to poultry include *oxytetracycline, chlortetracycline, penicillin, streptomycin, neomycin, dihydrostreptomycin, erythromycin, spectinomycin, tylosin, bambermycin, lincomycin, tetracycline and bacitracin,* (Bhatacharya and Taylor, 1974). Webb and fontenot (1972) observed that penicillin, oxytetracycline, chortetracycline, neomycin and zinc contained in poultry manure when fed at 25 or 50 % in a ration of steer for 112 or 198 days showed no detectable amount of tissue residue of the antibiotics, except for

chlortetracycline when the feed was withdrawn 5 days to the slaughtering of the steer.

Hormones: Presently, hormones are not permitted in commercial poultry rations. However, an incidence of abortion has been reported in cows fed broiler manure having oestrogenic activities of 10mg/100g as compared to 1mg/100g in forage crops (Griel *et al.*,1969). Hertelendy *et al.*,(1969) established the presence of 17-beta estradiol in the hen's urine. The presence of hormones in laying birds was found to be significantly less than in non- laying birds. However, Elmund *et al.*,(1971) observed that drying the manure at a neutral PH seems to destroy the activities of the hormones.

In Nigeria, the major drugs fed to poultry are the antibiotics, mostly used in disease control. No problem is likely to occur if the feeds containing the poultry manure is withdrawn five days before the cattle is slaughtered,(Webb and Fontenot 1972). Proper cooking has also been identified to decrease the activities of antibiotics (Huber, 1971),.

Copper toxicity is a likely problem, if the birds are fed copper sulphate (Fontenot, 1970). Fontenot (1970) recommended that droppings containing up to 100 ppm copper should be avoided especially for sheep. However, Lowman and Knight (1970,) showed that most of the copper in the manure may not be available to ruminants. No undesirable flavour on meat and milk of animals fed poultry manure has been observed(EL-Sabban *et al.*,(1970; Thomas *et al.*, 1972 and Bucholtz *et*

al., (1971) from result of taste panel.

2.6.5. Effect of processing methods on the quality of poultry manure.

Drying temperature.

Drying temperature has been found to decrease the nutrient content of poultry droppings. Sheppart *et al.*, (1971) observed an inverse relationship between the drying temperature and the resulting total protein found in the dried manure. When the manure was dried, at 650c for 24 hours, Manoukas *et al.*, (1964) observed a decrease of 1.2 - 20.2% and 7.1 -15.2% for energy and nitrogen respectively. In another study, Fontenot *et al.*,(1980) reported a decrease in nitrogen and ether extract from 42.5 and 6.3% to 34.4 and 2.9% respectively. Higher drying temperature and longer drying period seem to increase the loss of nitrogen from broiler excreta (Kubena *et al.*, 1973). When broiler manure was acidified to PH 6 prior to drying it reduced the Nitrogen loss. Contrary to the above observations , Brugman *et al*; (1967) did not observe any marked change in the chemical composition of broiler manure when heated at 135oc for 11hours. He however, noticed 7.6% depression in digestibility of the manure.

(b) Age of the manure.

Age of the droppings before drying has also been reported by Couch (1972) to result in 60% loss in nitrogen. Ensiling droppings with high moisturised ground corn at ratio

1 : 2 tended to preserve the nitrogen and increase the intake. Contrary to the above view, Shannon and Brown (1969) showed that heat treatment increased the nitrogen content of droppings from 4-10%. Air-drying which is the cheapest method of drying poultry manure has been observed to result in less loss of both CP and ether extract when compared to steam treatment (Long *et al.*, 1969).

MATERIALS AND METHODS

3.1 Experiment 1. Nutrient composition of poultry manure.

3.1.1. Introduction.

One major problem associated with intensive poultry production is that of waste disposal and with renew intrest in poultry farming, this problem is likely to be on the increase. About 2.2 million tons of poultry manure is expected from the 90 million Poultry in the country assuming the 70g waste per bird per day (Oluyemi and Robert,1979).this quantity of waste is capable of feeding about 10 million cattle for a year assuming daily intake of 700g. This in addition to alleviating waste disposal problem , will serve as an alternative to the more expensive conventional protein source for ruminants in the country .

The objectives of this study is to determine the variability in the nutrient composition of poultry manure by sampling farms with different management and feeding systems in attempt to obtain average values for the various nutrients.

3.1.2. Collection of the poultry manure samples.

Poultry manure was collected in nine farms in and around Zaria for the purpose of this experiment. The samples collected were in four groups; namely the layer manure, broiler manure, cock manure and pullet manure. The layer manure samples were of two types, the cage manure which was

collected from birds that are kept in cages and are in their first year of laying and the other was from birds on litters and are also in their first year of laying. In more than 70% of the farms where the manure samples were collected ,the samples were usually removed once in every month whereas in the remaining farms they were left for more than two months. The broiler manure was from birds that were between 5- 8 weeks of age except in the backyard poultry farm where the birds were about 10 weeks old. The pullet manure was from birds that were between 12 to 16 weeks old while the cock manure was from mature cocks of about 6 months of age. The samples were analysed at the National Animal Production Research Institute laboratory.

3.1.3. Chemical analysis of the samples.

Proximate analysis of the samples were determined using the method of A.O.A.C (1984). Dry matter (DM) was determined on duplicate samples by heating a known weight of sample at 100^{0}C overnight. The nitrogen content was determined according to the Kjeldahl sulphuric acid digestion technique and the nitrogen content so obtained was multiplied by 6.25 to give the CP content of the samples. The gross energy content was determined by combusting 1.2gm sample in a Gallenkamp adiabatic autobomb calorimeter. Neutral detergent fibre (NDF) and acid detergent fibre (ADF) of the samples were determined by the methods of Van Soest (1963). The calcium and magnesium contents of the samples were determined

by using the doubled beamed atomic absorption spectrophotometer model 760 while the phosphorus content was determined by using aoto analysing flame photometer (Corning flam Photometer 410) according to the method of whiteside, 1976.

3.2. Experiment 2. Growth trials with supplements containing poultry manure

Introduction.

Several authors (de Leeuw, 1971., Umunna and Agishi, 1988 and Blair rains, 1963) had shown the limitations of tropcal forages to provide reseonable Animal production.Hence the slow growth rate and the seasonal fluctuations in the growth rate of the cattle grazing natural pastures. Since majority of the cattle in the country are in the hands of the pasturalist, any effort to improve the performance of grazing animal will be commendable. Winter,(1992), however, suggested the protein supplementation. Considering the hige cost conventional protein sources, there is the need to incorporate cheaper sources of protein . Although, the use of poultry manure in livestock feeding is not new in the country, there is dearth of information on its utilization as supplements for cattle grazing natural pastures. Poultry manure is cheap and available and its incorporation in the supplements will reduce the cost of production and increase the profit margin of the farmers. In the current trial Layer and Broiler manure were chosen because of it availability.

The objectives of the two trials reported here are:

1. To determine the effect of feeding dried poultry manure (DPM) on the growth response of cattle grazing natural pastures during the wet season.

11. To determine the best level at which both sun-dried layer manure (SDLM) and sun-dried broiler manure (SDBM) can replace cotton seed cake without any detrimental effect on the health and the growth response of the cattle.

3.2.1. Trial 1:- The growth response of Friesian x Bunaji crossbred bulls grazing natural pastures and receiving supplements containing cotton seed cake (CSC) and sun dried layer manure (SDLM)

The trial was conducted in the National Animal Production Research Institute, Shika (Northern Guinea Savanns Zone) between August 1991 and January 1992 for a period of 112 days which correspond to late wet season and early dry season in this ecological zone. Shika is located on lat. 11o 15' and long. 7o 32'. The rainfall distribution during the year is presented in table 1.

Animal and management:-

Twenty eight Friesian x Bunaji crossbred bulls of live weight ranging between 60-190kg were blocked by weight and randomly allotted to seven groups. Each of the groups was balanced for weight and randomly allotted to each of seven treatments in a completely randomized design. The bulls were treated against ectoparasites and endoparasites before the treatments were imposed. Treatment against ectoparasites were

repeated weekly during the wet season and forthnightly during the dry season. Three of the bulls fell into the feeding trough and died during the trial.

Treatments and feeding:-

The treatments consisted of dried layer waste replacing cotton seed cake at 0,20,40,60 80 and 100 percent weight for weight. Another group of bulls which served as the control was not supplemented. The layer manure used in the trial was obtained from caged hen house in NAPRI. The manure was sun-dried for six days during the previous dry season in February. The CP content of the supplements range between 17.13 to 23.38 percent. The supplements were fed at 10% of estimated dry matter intake on individual basis in the morning before the bulls were grazed on the range. Left over of the supplements were weighed the following morning to obtain the supplement intake.

Parameters measured:-

(i) Liveweight:-

The bulls were weighed at the beginning of the trial and at two weekly intervals and at the liveweights were used to estimate liveweight changes.

(ii) Rumen ammonia concentration:-

At the end of the trial, rumen fluid samples were collected two hours after feeding the supplements from each bull. About 30-40mls of the rumen fluid was drawn from each animal using a stomach tube which was about 150 cm long with

a metallic rumen fluid strainer attached at the end. The tube was passed through a pipe placed in the animal's mouth, this was to prevent the animal from bitting the tube. A suction pump through which the fluid was drawn was attached to the other end of the tube. The fluid was preserved with an equal quantity of IN sulphuric acid (H_2SO_4) to trap the ammonia from escaping and frozen until analysed. Rumen ammonia was estimated by steam distillation into boric acid and back titrated with 0.01 N Hcl (Whitehead et al., 1976). the rumen amonia concentrations were calculated in mg/100ml of the rumen fluid.

(iii) Supplement intake:-

Left over of the supplements offered were weighed every morning from where supplement intake was estimated by difference.

3.2.2. Trial 2:- The growth response of bunaji bulls grazing natural pastures and receiving supplements containing cotton seed cake (CSC) and sun-dried broiler manure (SDBM).

This trial took place during the wet season between August and November 1992 and lasted for 98 days. Because of lack of enough animals we could not replace CSC with sun-dried broiler manure from 0 to 100 level as in the first trial.

Animals and management:-

Twenty Bunaji bulls (Average weight 117.00±6.00 kg)were used. The bulls were blocked by weight and randomly allotted

to four treatments in completely randomised design. Before the treatments were imposed, the bulls were treated against ectoparasites and endoparasites. Treatment against ectoparasites was repeated every week throughout the experiment.

Treatments:-

The treatments consisted of sun-dried broiler manure (SDLM) replacing CSC at 25, 50, and 75 percent weight for weight. Another group which served as the control was not supplemented.

Preparation of supplements:-

The manure was collected from a deep litter house in NAPRI, and was sun-dried for six days during the dry season (February) and stored until needed. The supplements were fed at 15% of estimated dry matter intake to the bulls individually in the morning before they were grazed on the range for eight hours. Any supplement not consumed was weighed the following morning and the weight used to estimate supplement intake by difference.

Parameters measured:-

(i) Liveweight

The bulls were weighed at the beginning of the trial and forth-nightly afterwards, the supplements offered were adjusted based on the new weight. On each weighing day, body condition score, using Pullan (1978) method, was recorded by two scores and the average taken.

Rumen ammonia concentrations:-

Rumen fluid samples were collected two hours after feeding the supplements at the end of the trial from each of the bulls. The procedure of collection and analysis were the same as described in trial 1.

Plasma minerals concentration:-

About 10ml of blood was taken from the Jugular vein of each bull three times during the trial. These were (i) A day before the start of the trial (17/8/92), (ii) mid stage during the trial (29/9/92) and (iii) at the end of the trial (10/11/92). A small quantity of anticoagulant, EDTA (Ethylene diamine tetra acetic acid) was added to the blood sample at collection and then centrifuged to separate the plasma from blood cells. The decanted plasma was then preserved in a refrigerator at 40C and used in the determination of calcium and magnesium using the atomic absorption spectrophotometer model 960 (Shimadzu). Phosphorus was determined by using the auto analysing flame photometer (Corning flame photometer 410) according to the method of Whiteside, 1976.

Rainfall record:-

The rainfall data for the two years (1991 and 1992) of the trial are presented in table 1.

Table 1. Summary of rainfall (mm) data during the two years (1991 and 1992) grazing trial.

Months	Year 1 (1991)	Year 2 (1992)
April	1077.72	589.28
May	7990.66	2283.46
June	4137.28	5590.54
July	6177.28	5590.54
August	8663.94	8087.36
September	2052.32	5628.64
October	1080.77	744.22
Total	33187.13	25976.58
DEF	64	64

DER = Days of effective rain.

Source :-NAPRI meteorology section

Statistical analysis : -

Data generated from the two grazing trials were analysed using the general linear model (GLM) procedure of statistical analysis system, SAS (1987) and the means were separated using the Least Square Difference (LSD) Steel and Torrie (1960). Samples of forage grazed by the bulls were collected twice during each trial and identified.

CHAPTER FOUR

RESULTS AND DISCUSSION.

4.1. RESULTS.

4.1.1 Experiment 1.

Table 2. shows the chemical composition of sun-dried poultry manure. The dry matter content of the various poultry manure sources tested was about 97+0.93 %. The energy content of the manure ranged between 3.29 to 4.21 kcal/kg, with layer manure having the lowest value while broiler manure had the highest energy value. Ash content of the manure ranged between 16.16 and 28.96% , layer manure had the highest while broiler manure had the lowest. The crude protein content of the manure varied widely between 15.65 to 25.58 %. The highest value came from broiler manure and the lowest from layer manure. The CP values for cock and pullet manure fell between those of broiler and layer manure. NDF and ADF values of the tested manure are within the range of 44.47-49.25% and 19.40-22.45% respectively.

The highest levels of calcium, phosphorus and magnesium were obtained from layer manure, while the lowest level for calcium, phosphorous and magnesium came from the broiler, cock and pullet manure respectively.

Table 2: Chemical composition (% DM) of sun-dried poultry manure

	Type of poultry manure			
Parameters	SDLM	SDBM	SDPM	SDCM
Dry matter	97.53	97.93	97.54	97.68
CP	16.13	25.58	18.45	15.65
NDF	47.62	44.47	46.55	49.25
ADF	20.31	19.40	19.75	22.45
GE(Kcal/KG	3.29	4.21	3.57	3.49
Ash	28.93	16.16	20.91	21.44
Calcium	6.10	2.50	2.89	2.83
Phosphorus	2.50	1.80	1.33	1.50
Magnesium	0.49	0.38	0.28	0.21

SDLM = Sundried layer manure

SDBM = sundried broiler manure

SDCM = sundried cock manue

SDPM = sundried pullet manure

Experiment 2. Trial 1.

The chemical composition of the supplements fed in experiments 2. trial 1. are presented in table 3A.

Table 3A: Chemical composition of the supplements fed to the bulls during the first (1991) trial.

	Percent SDLM in CSC supplements					
Parameters	0	20	40	60	80	100
DM%	97.26	96.31	96.23	95.81	95.76	95.72
C.P.%	23.38	21.56	21.75	23.19	18.75	17.13
GE(KCAL/Kg)	4.86	4.75	4.00	3.91	3.46	3.34
NDF %	50.56	46.94	40.26	33.62	26.95	22.64
ADF %	23.06	29.00	33.56	38.31	42.97	40.79

(KJ/g=KCal/gx4.184)

The predominant forage species on the range where the bulls were grazed during the two trials include *Cynodon dactylon, Cenchrus ciliaris,Andropogon gayanus, Hyparrhenia spp, Sporobolus spp, Tephrosia bacteolata, and Stylosanthes mucronata* .

Average daily gains and rumen ammonia concentration of bulls used in trial 1 are presented in table 4. The results indicated that, replacing CSC with SDLM significantly ($P<0.05$) influenced the daily weight gains and supplement intake but had no effect ($P>0.05$) on the rumen ammonia concentrations. Intake of the supplements decreased as the proportion of SDLW in them increased, when CSC was replaced

at 20,40,60,80 and 100% with SDLW. Intake of the supplement decreased by 9.25, 6.84, 23.58, 38.81 and 58.11 percent respectively. Rumen ammonia concentrations of bulls fed various supplements varied between 12.51 - 9.13 mg/100ml. Although, increasing SDLM in the supplement had no significant (P>0.05) effect on the rumen ammonia concentration, the supplemented groups had higher rumen ammonia concentration than the control group.

Daily weight gains of bulls during the trial ranged between 0.525 -0.297kg. The weight gains increased as the proportions of SDLW increased in the supplements, then peaked at 60% level of replacement after which it declined. Percentage improvement in daily weight response of supplemented bulls over the control group are 43.43,11.34 39.38, 40.24, 26.67 and 21.64 for the treatment containing 0,20,40,60,80 and 100% SDLW respectively.Also, the bulls receiving CSC alone had the best weight response which is about 36.19, 6.67, 5.33, 22.86 and 27.81 percent better when compared to those receiving supplement containing 20, 40, 60, 80 and 100 percent SDLW.

The supplement consumed per kilogramme body weight decreased (P<0.05) as the proportion of SDLW increased in the supplements. The cost of supplement per kilogramme gain decreased from 1.97 to 0.11 Naira as the proportion of SDLW increased in the supplement.

Table 4: Supplement intake,rumen ammonia concentrations and live-weight gains of bulls grazing natural pastures and receiving supplements containing sun-dried layer manure (SDLM) and cotton seed cakes (CSC).

Parmeters	Control No supplement	Percent SDLM in CSC supplement 0	20	40	60	80	100	LSD
Numbr of bulls	3	4	4	3	3	4	4	
Initial weight (kg)	113.33	116.25	117.50	140.00	100.00	120.00	107.50	
Final weight (kg)	146.67	175.00	155.00	195.00	155.67	165.00	158.00	
Total gain (Kg)	33.33^{c}	58.75^{a}	37.50^{ab}	55.00^{ab}	55.67^{ab}	45.00^{ab}	42.50^{ab}	15.65
Average daily gain (kg)	0.297^{c}	0.525^{a}	0.335^{bc}	0.490^{ab}	0.497^{ab}	0.405^{abc}	0.379^{bc}	0.14
Percent improvement over the control	-	43.43	11.34	39.38	40.24	26.67	21.64	
Suppl.intake (g/day)	-	447.59^{ab}	401.32^{bcd}	417.32^{ab}	338.57^{bcd}	270.80^{dc}	211.96^{d}	130.09
Rumen ammonia concentration mg/100ml)	9.13	11.12	11.51	10.41	11.87	10.59	9.87	3.02
Supplement intake/ gain (Kg/kg)	-	0.84^{b}	1.20^{a}	1.02^{a}	0.67^{b}	0.67^{b}	0.56^{b}	0.42
Cost of supplement (N/kg)	-	1.68	1.97	1.31	0.63	0.38	0.11	

^{a,b,c,d} Means on the same rows with different superscript differ significantly ($P<0.05$)

Experiment 2.trial 2.

The chemical composition of the supplement (CSC:SDBM) is presented in table 3B.

Table 3B: Chemical composition of the supplements fed to the bulls during the second (1992)) trial.

Parameters	Percent SDBM in the supplements		
	25	50	75
DM %	96.08	95.45	95.21
CP %	23.56	24.31	22.81
ADF %	29.38	36.50	27.95
NDF %	45.02	34.42	39.44
GE(Kcal/kg)	4.32	3.98	3.24
ASH %	16.71	19.67	16.41
Calcium %	2.01	2.29	2.92
Phosphorus %	1.44	1.53	1.70
Magnesium %	0.45	0.47	0.21

Performance data of the bulls used in the trial are presented in table 5. The results showed that replacing SDBM with CSC had a significant effect ($P<0.05$) on the daily weight gains, rumen ammonia concentrations, cost of supplement per kilogramme gain and body condition score, but the effect on the intake of the supplements was not significant ($P>0.05$). Daily intake of the supplement varied between 743.78 to 813.11 grammes. Supplementation Significantly ($P<0.05$) elevated the rumen ammonia

concentration above those of control group. Supplementation with 25, 50 and 75% SDBM, elevated the rumen ammonia concentrations of the bulls above those on the control by 50.41, 100 and 49.75 % respectively.

Daily weight gains of bulls reorded during the trial ranged between 0.159 to 0.512 kg The weight gain increased with increase in the level of SDBM in the supplement up to 50% level of replacement then it declined. Supplementation improved daily weight gains by 60.92% when compared to the control. Bulls receiving supplement containing 50% SDBM improved the daily weight gains by 222.01, 49.22, and 40.27 percent when compared to those on control, 25 and 75% SDBM inclusion levels.

Supplement consumed per kilogramme gains was lowest for bulls receiving 50% SDBM. Cost of supplement consumed per kilogramme gain decreased as the level of SDBM increased in the supplement. Body condition score was highest for bulls on 50% SDBM inclusion diet and improved as the trial progressed.

Table 5: Supplement intake, rumen ammonia concentrations , and weight gains of bulls grazing natural pastures and receiving supplements containing sun-dried broilers manure (SDBM) and cotton seed cakes(CSC).

Parameters	control (No supplement)	percent SDBM in CSC suppement 25	50	75	LSD
Numbers of bulls	5	5	5	5	
Initial weight (kg)	187.00	170.00	178.00	179.00	
Final weight (kg)	202.60	204.00	228.20	214.80	
Total weight gain (kg)	15.60^{c}	33.60^{b}	50.20^{a}	35.80^{b}	8.44
Daily gain (kg)	0.159^{c}	0.343^{b}	0.512^{a}	0.365^{b}	0.084
Percent weight improvement over control	-	115.72	222.01	129.56	
Total suppl. consumed (kg)	-	72.89	76.69	77.37	12.63
Daily suppl. consumed(g)	-	743.78	813.11	789.50	128.87
Rumen ammonia Conc.(mg/100ml)	6.03^{b}	9.07^{ab}	12.30^{a}	9.03^{ab}	3.66
Suppl.consumed/ gain (Kg/kg)	-	2.17^{a}	1.59^{b}	2.16^{b}	0.23
Cost of suppl.(N/Kg)	-	3.36	1.75	1.41	
Body condition score	4.56^{b}	4.64^{b}	4.80^{a}	4.63^{b}	0.20
Plasma Calcium conc.(Mg/100ml)	10.47	10.13	10.27	10.43	2.40
Plasma Magnesium. conc.(Mg/100ml)	1.27	1.20	1.17	1.20	0.39
plasma phosphorus. conc.(Mg\100ml)	11.35^{b}	12.36^{ab}	14.19^{a}	14.15^{a}	3.22

^{a,b,c} Means on the same row with different superscript differ significantly ($P<0.05$)

Data on plasma calcium, magnesium and phosphorus concentrations are presented in table 6. Before the treatments were imposed, the calcium and phosphorus concentrations of the bulls differed between treatments. But magnesium was similar. As the trial progressed (second sampling) both the calcium and magnesium except for phosphorus concentration became similar (P>0.05) and at the end of the trial.

Table 6: Plasma calcium, magnesium and phosphorus concentrations (kg/100ml) sampled at three different stages from bulls grazing natural pastures and receiving supplements containing SDBM and CSC.

		TREATMENTS.				
Time of sampling	Minerals	No supplement	Percent SDBM in CSC Diet 25	50	75	LSD
Before commencing the trial (1) 18/8/92	Ca	10.80[a]	9.10[ab]	8.20[b]	8.40b	1.74
	Mg	1.10	0.90	1.00	1.10	0.26
	P	11.74[b]	14.07[ab]	16.12[a]	16.64[a]	3.97
Mid stage into the trial (II) 29/9/92	Ca	10.50	9.80	11.10	11.50	3.28
	Mg	1.50	1.40	1.30	1.30	0.51
	P	11.39[b]	13.73[ab]	12.67[ab]	15.19[a]	3.32
End of the trial 10/11/92	Ca	10.10	11.40	11.20	11.00	2.14
	Mg	1.20	1.30	1.10	1.20	0.35
	P	10.73	11.78	10.31	10.59	3.03

[a,b] Means on the same row with different superscript differ significantly (P<0.05)

Inclusion of SDBM did not show any effect on the plasma concentrations of calcium and Magnesium except for Phosphorus.(table 5). Time of sampling significantly affected ($P<0.05$) the concentration of the minerals (table 7). It was observed that plasma calcium concentrations decreased as the trial progressed and became different ($P<0.05$) during the second sampling time. plasma magnesium concentration increased as the trial progressed up to the second sampling time then declined slightly. The phosphorus concentrations decreased as the trial progressed.

Table 7: Effect of time of sampling on the plasma calcium, magnesium and phosphorus concentrations (Mg\100ml) of bulls grazing natural pastures and receiving supplement containing SDBM and CSC. CAKE (CSC)

	DATE OF SAMPLING			
Minerals	(18/8/92)	(29/9/92	(10/11/92	LSD
Calcium (mg/100ml)	9.20^{b}	10.75^{a}	11.03^{a}	2.40
Magnesium (mg/100ml)	1.0^{b}	1.38^{a}	1.23^{a}	0.38
Phosphorus (mg/100mg)	14.70^{a}	13.48^{a}	10.86^{b}	3.22

^{a,b} Means on the same row with different superscript differ significantly ($P<0.05$).

4.2. DISCUSSION

The higher crude protein content of broiler manure than the layer, cock and pullet manure obtained in this trial agreed with the findings of other workers (El-Sabban *et al.*, 1967, Fontenot and Bhattacharya,1965). The major reasons responsible for the difference in the content is the differences in the crude protein content of various diets fed to the birds (Smith, 1974). The crude protein contents of the broiler and layer manure obtained in the trial are lower than those reported by Smith (1974), Polin *et al.*, (1971) and El-Sabban *et al.*, (1967), but higher than the values reported by Oluyemi and Robert (1979).

The gross energy content (k cal/kg) of poultry waste is lower than what is found in most foodstuff and the major reason put forward is the high ash content of the manure (Lowman and Knight, 1971). This trial confirms the above observation as shown by the inverse relationship between the gross energy and the ash content of the manure (Table 2).

The results of the mineral composition of poultry manure is similar to what other workers have reported (El-Sabban *et al.*, 1971). The higher phosphorus, calcium and magnesium contents of layer manure as compared to other manure is because of the higher content of these minerals in the layer diet, which is required for egg shell formation. In

addition, egg content and shell from broken eggs which are usually found in layers manure will all contribute to mineral content of the manure.

During the 1991 feeding trial, the decrease in intake of the supplement as the proportions of dried layer manure increased in the diet may have been due to the grittiness and unpalatable nature of the manure (Holzer and Lavy, 1976). This observation is however, contrary to those of Belgado *et al*., (1978). Intake of supplement containing SDBM during the 1992 trial was better as all the supplement offered was consumed although that it was offered at higher proportions. It can however, be concluded that broiler manure is more palatable than the layer manure. The main reason responsible for this could be the better aroma associated with broiler manure.

Rumen ammonia concentrations (mg/100ml) during the two (1991 and 1992) trials were higher than the 5mg/100ml required to achieve maximum bacterial synthesis,(Satter and Slyter, 1974 and Okorie *et al*., 1977). Hence, intensive microbial activities which would enhance higher ingestion and feed utilization is expected (Hungate, 1966).

The poor performance of non supplemented bulls during the two trials is expected because the supplements that was given to other bulls provided additional nutrient which is limiting in the forages. The results further confirm the observation of Winter, (1991) that, the performance of cattle

grazing natural range in the tropics can be improved through protein supplementation. The increasing weight gain associated with increasing level of manure was not absolute but only to a point after which increasing poultry manure did not attract further gains. This could be attributed to better nutrient availability and utilization by the bulls. This result is in conformity with those of Belgado *et al.*, (1976) using CSC with cattle on tropical forage in cuba. Bulls on cotton seed cake supplement performed better than other supplemented group during the 1991 trial because natural protein contains better amino acid profile which are made available at the lower gut of the ruminant and hence influence better weight response (Williams *et al.*, 1969).

Several reasons have been but forward to be responsible for the trend in weight gains in the trials. Since intake of forage is influenced more by protein containing supplement than the NPN (Sriskandaraja *et al.*,1982 and Clanton,1978), forage intake is therefore, expected to decrease at certain proportion of poultry manure in the diet. Poultry manure containing about 50-60% NPN compound can supply enough ammonia for the growth of cellulolytic bacteria provided other nutrients are present (Elias, 1971 and Bryant, 1973). The need to provide some quantity of dietary protein has however, been pointed out (Belgado, 1978). This become necessary because some bacteria require amino acid and peptides (Hungate, 1966) and VFA (Bryant and Robinson, 1962)

for growth. Since the rumen ammonia concentrations during the two trials were more than the 5mg/100ml reported to provide maximum protein synthesis for all bulls in different treatments, then the major factor influencing performance difference between group is the proportions of dietary protein that bypass rumen degradation. This observation was also made by Minson, (1975), Johnson, (1976) and Chalupa *et al.*, (1969). Since the weight gains of bulls fed CSC supplement and those on diet containing 40 and 60 % SDLM during first trial . were similar, this represent the level at which SDLM can replace CSC and during the second trial bulls on diet containing 50% SDBM also represent the best level at which SDBM can replace CSC. These levels provided the highest rumen enviroment for effective rumen activities as indicated by the highest rumen ammonia concentrations (11.87 and 12.30 mg/100ml) of bulls on these treatments (tables 4 and 5). Hence, higher proportion of CSC would have escaped the rumen degradation and resulted in better performance.

The decline in weight response at higher poultry manure inclusion (i.e. above 60% and 50% during first and second trials respectively), can be associated with decreased nitrogen retention and crude protein digestibility (Bhattacharya and Frontenot, 1966, Belgado *et al.*,(1978, Tinnimit *et al.*, 1972).

Because of the low cost of the poultry manure, the cost

of the supplement per kg weight decreased as the manure increased in the supplement. It is therefore, important to strike a balance between the cost per gain and the actual response of the bulls. This is important because, it could be misleading to rely solely on cost per gain alone.

Phosphorus deficiency is the most widely spread and economically important of the minerals affecting grazing livestock (Underwood, 1981). Throughout the period of the trial, the concentrations of the minerals in the plasma were higher than the minimum requirement for growth (Little 1970,Oduyi and Fasanmi 1971 ,Gartner 1980). Because these trials involved grazing, it became difficult to control what the bulls were selecting which may contribute to the mineral intake by the bulls. The high Ca, and P. concentration at the start of the trial could be due to the homeostatic mechanism involving the parathyroid hormones which maintain a constant level during deficiency. The steady increase in plasma calcium concentration as the trial progressed can be explained as follows. As the forage ages, the phosphorus content declines and because the requirement of the animal is not met, the body reserve is mobilized and in addition to the minerals supplied by the supplements, more calcium and phosphorus are found in the plasma. Since phosphorus is the most needed minerals, the surplus calcium will increase its level in the plasma (Underwood 1969). It is not surprising that the concentration of magnesium and

calcium are higher than required by the bulls even at start of the trial. This is because most tropical forages can supply enough to meet the requirement of cattle (Tanko *et al.*,1992).

It is important to state that plasma mineral levels may not give the best assessment of the minerals status of livestock, most especially for Calcium and Phosphorus. This is because the plasma mineral level is an integration of minerals supplied by both dietary and body sources, this is probably why the treatment could not exhibit any effect on the serum mineral levels.. In the case of Magnesium the method can be suitable since no labile body store of Magnesium in significant magnitude exists (Hacker 1981).

In conclusion, the results of these studies indicate that poultry manure is a good and cheaper source of nitrogen for ruminant grazing tropical forages. The manure can also serve as good source of mineral . Broiler manure is more palatable than the layer manure. Both layer and broiler manure can replace up to 50% of cotton seed cake supplement and this resulted in 43.1% and 222% increase in liveweight gains when compared to the bulls that were not supplemented and about 50% reduction in the cost of the feed.

There was no clinical sign of danger emanating from feeding dried poultry manure throughout the durations of the two trial. This is probably because drugs such as arsenic,

hormones and copper sulphate which are potential source of danger to livestock feeding on poultry manure containing them are not usually fed to poultry in Nigeria. Even in places where these drugs are fed to birds, there has not being any evidence in the literature to provide any historical case to the danger of feeding poultry manure. Feeding poultry manure to ruminants will also help to reduce the huge loads of manure there by eliminating the danger of pollution.

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