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Sudan University of Science and Technology

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The Effect Of Moringa Olifera(leaves and pots) On Desert Sheep Performance

أثر إستخدام المورينقا اولوفيرا(الأوراق والقرون) على أداء الأغنام الصحراوية السودانية

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الآية

قال تعالى:

﴿ وَمَا مِن دَآبَّةٖ فِي ٱلۡأَرۡضِ وَلَا طَٰٓئِرٖ يَطِيرُ بِجَنَاحَيۡهِ إِلَّآ أُمَمٌ أَمۡثَالُكُمۚ مَّا فَرَّطۡنَا

فِي ٱلۡكِتَٰبِ مِن شَيۡءٖۚ ثُمَّ إِلَىٰ رَبِّهِمۡ يُحۡشَرُونَ ﴾ صدق الله العظيم

سورة الأنعام الآية (38)

Dedications

My deepest gratitude and sincere appreciation,

To my family, my dearest sisters, and brothers,

All of them gifted this work, and, whose sincerity is beyond expression.

Eman

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Thanks to Allah for health, assistance, and patience, he has given me to complete this work.

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ABSTRACT

This experiment was conducted at the experimental farm of Sudan university of science and technology in the pens with open system in order to compare the values of moringa olifera at different rates(22%-25%) and others ingredients as addatives diets to the ground nut cake, the experiment contained of 16 ewes of hamari sheep and were divided into three unit ,four ewes at rate per unit ,the experiment started at the age (1-2) years of age of ewes and continued for four weeks, measurement that it takes was feed intake and body weight gain.

The results showed that the highest dry matter (DM), (93%) was recorded for moringa olifera(22%) and the lowest(90%) obtained for moringa olifera(25%) and groundnut cake generally there were significant differences (p>0.5) between three treatments.

Crude protein (CP) was highest(21.17) for moringa olifera (22%) and lowest (20.18) ,(16.28) for groundnut cake and moringa olifera(22%). The differences between three treatment were significant (p<.05).

Crude fiber (CF) was highest (16.60) for moringa olifera (22%) and lowest amount recorded for groundnut cake (13.60).the differences were significant (p>.05) between three treatment .

The either extract was highest(4.60) for moringa olifera (22%) and lowest for grountnut cake and moriga olifera (25%) ,there were significant differences (p>.05) (T1),(T2) and (T3) and no significant between (T2) ,(T3).

The metabolic energy (ME) was highest (8.200mg/kg) for moringa olifera(22%) and lowest (7.449mg/kg).(7.322mg/kg) for groundnut cake and moriga olifera (25%). The differences were significant between three treatments.

The crude ash was highest (12.17) for moringa olifera (22%) and lowest (10.74),(9.87) for moringa olifera (25%) and ground nut cake. The differences were significant (p>.05) between three treatment.

The highest weight gain (30.25kg) was recorded for (T1) moringa olifera (22%) and lowest amount recorded (27.38kg) for (T2) moringa olifera(25%) The differences were significant (p>.05) between three treatments.

The highest feed conversion ratio was recorded for (T3) moringa olifera 25% and lowest amount recorded for ground nut cake and there were significant differences between treetments.

The highest feed intake was recorded for (T2) moringa olifera 22% and lowest amount recorded for (T3)moringa olifera 25%, the differences were significant(p>.05) between three treatments.

الخلاصة

تم إجراء هذه التجربة في المزرعة الخاصة بجامعة السودان للعلوم والتكنولوجيا في حظيرة ذات النظام المفتوح بهدف المقارنة بين عليقه تحتوى على أمباز فول كمركز تجارى وعليقه تحتوى على مورينقا اولوفيرا بنسب متفاوتة(22-25%) كإضافة للمركز التجاري .

إحتوت التجربة على 16نعجه من الضأن الحمري وقسمت إلى ثلاثة وحدات بمعدل أربعه نعاج لكل وحده. بدأت التجربة في عمر (1-2) سنه من عمر النعاج وإستمرت لمدة أربعه أسابيع ، القياسات التي أخذت هي معدل إستهلاك الغذاء ووزن الجسم.

أظهرت النتائج أن أعلى معدل للمادة الجافة كانت 93% تم تسجيلها للمورينقا ذات النسبة 22% ، وأقل معدل سجل للمورينقا 25% ، وأمباز الفول سجل 29,10 عموما الفروقات كانت معنوية بين كل المعاملات.

معدل البروتين الخام كان أعلى للمورينقا 22% وكان 21.17 وأقل معدل 16.28 للمورينقا 25% وكانت الفروقات معنوية بين الثلاث معاملات .

معدل الألياف الخام كان أعلى للمورينقا 22% ،16.60 وسجل أمباز الفول أدنى معدل 13.60 كانت الفروقات معنوية بين المعاملات .

سجل الدهن الخام أعلى معدل عند المورينقا 22% وكان 4.60 ، وأدنى معدل 2.80 سجل لأمباز الفول والمورينقا 25% وكانت الفروقات معنوية بين (المعامله1) و(المعامله2) و(المعامله3) ولكن لا فروق معنويه بين (المعامله2) و(المعامله3).

الطاقة التمثيلية سجلت أعلى معدل 8.200جم/ميقاجول عند المورينقا 22% وكانت أدنى 7.322جم/ميقاجول عند المورينقا 25% ، وكانت الفروقات معنوية بين كل المعاملات .

سجلت المعادن أعلى معدل 12.17 للمورينقا 22% وكان أدنى معدل 9.87 لأمباز الفول وكانت الفروقات معنوية بين المعاملات.

أعلى معدل للوزن المكتسب 30.25كجم كان للمورينقا22% وأدنى معدل27.28كجم و سجل للمورينقا 25% وكانت الفروقات معنوية بين المعاملات.

أظهرت النتائج ان أعلى معدل للكفاءة التحويليه للعلف سجلت لمورينقا ذات النسب (25%) وأقل معدل سجل لأمباز الفول .

كما أظهرت النتائج أن أعلى معدل لإستهلاك الغذاء اليومى سجل عند المورينقا (22%) وأقل معدل سجل عند المورينقا (25%) وكانت الفروقات معنويه بين المعاملات .

CHAPTER ONE

INTRODUCTION

1-1 Introduction

Livestock plays a very important role as an integral part of farming and rural life in developing countries, providing food and the critical cash reserve and income for many farmers who grow crops essentially for subsistence purposes (Preston & Leng1987).

One of the major factors limiting the productivity of small ruminants in developing countries is the over-dependence on low digestibility feeds which at certain periods of the year cannot meet even the maintenance requirements of these animals (Sarwatt *et al*, 2004). Categorized these feed resources as high fibre low protein feeds having organic matter digestibility between 30 – 45 % and they include native grasses, crop residues and fibrous agro-industrial waste products. They form the bulk of feed consumed by small ruminants in tropical countries because they are produced in large quantities and are relatively cheap since they are not competed for by man or monogastric animals**.** (Preston & Leng.1987).

The low nutritional plane greatly hampers the productivity of these animals especially during the dry season when the crude protein content of the feedstuffs could be as low as 2% (Sarwatt *et al*.,2004).This leads to slow growth rate, loss of body weight, low birth weight, predisposition to diseases as well as maternal and off spiring death. A balance of protein and energy with other essential nutrients is required to improve the productivity of small ruminants (Mendietta-Araica *et al*., 2010).

Scientists have advocated the feeding of supplements such as concentrates as part of the ways to improve the productivity of small ruminants (Aregheore *et al*., 2004; Walker *et al*., 2005).

Concentrate feeds promote rapid growth of ruminants, reduce ruminal methane production and increase propionate production, thereby lowering energy losses and contributing to higher efficiency of nutrient utilization (McDonald *et al*., 1996). Thus agricultural products such as groundnut have become expensive and scarce (Abubaker *et al*., 2010). Some species of cotton contain gossypol, an antinutritional component, which is detrimental to animal health. It has thus become imperative to source for other unconventional protein rich plant sources as concentrate feed stuffs for small ruminants.

Moringa oleifera is a drought tolerant multipurpose tree native to the sub Himalayan regions of India which has now naturalized in many tropical areas (Ramachandran *et al*, 1980). The high biomass accounts for more readily available cheap feedstuff. The leaves are highly nutritious, containing high crude protein including the sulphur containing amino acids, vitamins, minerals and energy (Makkar and Becker 1996).

Moringa oleifera leaves can be processed into leaf meals which contain higher nutrients and lower anti-nutritional factors than the fresh leaves (Makkar and Becker, 1997).

1-2 Objectives:

1. To evaluate the effect of feeding moringa oleifera leaves on growth performance of growing sheep.
2. To Increase the nutritive value of low quality forages and improve the animals performance
3. To reduce the cost of feeding additives groundnut cake with moringa oleifera.

CHAPTER TWO

LITERATURE REVIEW

2-1 Population of sheep in Sudan

Over the same period, the number of sheep has grown at 2.8% per year, and so the proportion of sheep in Sudan's livestock population has remained constant at about 36 %(Watson et al, 1977) . Sheep therefore play an important social and economic role in the country, and are a valuable strategic resource for both local and export purposes. (Bennett et al, 1948), More than 65% of the sheep in Sudan are of the Sudan Desert breed. Compared with the other types, this breed has remarkable productive and marketing features, and so is given priority in research and development programs. Current attitudes to modern agriculture and livestock production in the irrigated areas have stimulated the idea of integrated cereal crop and livestock farming as a means of maximizing production. As a result of improved feed resources (natural grazing, agricultural byproducts and grown fodder) due to the presence of abundant water, there is good potential for sheep production in the irrigated areas. This is confirmed by the large number of sheep reared in these areas (about 28% of the national population), (Preston et al. 1987).

(Sulieman **et al.1985) reported that Sudanese** sheep descends from a group of Asian horned sheep, a sheep with hair and a long tail , which is divided into seven main groups as follows, Sudan desert sheep, Western Africa sheep, Nilotic sheep Group, Dry tropical areas sheep, Dwarf sheep, Hybrid sheep, Northern nilotic sheep.

2-2 Sudan desert sheep

(Sulieman , Ali.1985.) reported that.Sudan desert sheep Origins. Probably descended from ancient Egyptian stock. Sub-types and races. Many "tribal" types have become recognized in recent years including Ashgur,Dubasi, Watish, Kababish and Baqqara. Other classifications include Gezira and possibly Barka and Wollega in Ethiopia. A "fused ecotype" of Sudan Desert x Southern Sudan has been recognized in a central belt of Sudan.

2-2-1 Management systems

Mainly pastoral but grading into agro-pastoral and urban and similar to those described for Sudan Desert goat, Flock sizes are large. Flock structure is related to meat and/or milk production.

The desert sheep group is one of the most important breeds in Sudan which represent more than 65% of the total population of sheep in the country. And around Nile east to the Ethiopian border and west through Kordofan and Darfur states reaching Sudan's western borders. These breeds are Similar in features but varies in color according to regions, it is commonly known by the tribes that reared or where they live. It is generally characterized by its good quality of meat, the average live weight of desert sheep is about 41 kg. It is mainly includes Kababish , Butana , Witesh ,Elgazeera ,Meedob ,Biga , Dobasi and Ashger breeds Constitutes 65% of the sheep population in the Sudan.(Mohamed Alamin et al,1978).

Kababish Sheep The most important types of Sudanese sheep breeds in terms of numbers and contributing to the export and domestic consumption, this breed reared by Kababish tribes in addition to Alquahla, Alhoawir, Alhumur, Jawamah, Dar Hamid, Albidairia, Bany garra and Alhassaniya tribes, this breed characterized by its large size and long legs, has no horns, the dominant color is brown red, it is considered as one of the best meat and milk sheep in

Sudan. this breed distributed over the desert areas west to the Nile along to the Chadian border(Mohamed Alamin et al,1978).

2-3 Animal feed resources in Sudan

In Sudan livestock obtain feed from:

1-Gazing and browsing on natural pastures

2-Crop restudies and agro-industrial by products

3-cultivated pastures and forage crops. (Izeldin, 2008).

2-3-1-Grazing and natural pastures*:*

Range and pasture is the backbone of livestock production in the Sudan in general. The growth of forage plants and grazing grasses undoubtedly depends on the rainfall. And due to the droughts and shortage of rains in the last thirty years, the productivity of natural pasture has decreased (Abduljabbar 2014). The availability and quality of native rangelands available to livestock vary with altitude, rainfall, soil type and cropping intensity. Total range area in Sudan is 279 million feddan. The productivity of this area is estimated as 78 million tons of dry matter (DM) and constitutes about 87% of the animal feed resources (AOAD, 2001). This feed resources is not enough to supply nutrients required by 65 million livestock units (LU), (1 LU is equivalent to a 250 kg animal), available in the country. This shortage is due to deterioration of grasslands particularly in the semi-desert and low rainfall savannah regions, expansion of agricultural mechanized schemes and destruction of pastoral resources through fire and overgrazing (Abu Swar and Darag, 2002).

Crop residues are produced in abundance. They include cereal straw (sorghum, wheat and millet straws), sugarcane byproducts (sugarcane tops) groundnut and cotton byproducts. Crop residues according to (Abu Swar and Darag, 2002) yield about 22 million tons of dry matter. In spite of the availability of these byproducts in Sudan, they are not fully utilized. Crop residues and agricultural byproducts could be used as an alternative animal feed. However the energy content of these byproducts is poorly utilized by rumen microbes due to the presence of the lingo cellulosic components which are either indigestible lignin or acting as a barrier between the potentially digestible fraction (cellulose and hemicelluloses) and the digestible enzyme (McDonald *et al*., 2002). Recently, the enzyme lignose is produced from fungi and yeasts in abundance, this provide the evidence for the feasibility of developing a composite microbial system with high capability of degrading straw lignocelluloses in order to make reasonable use of straw resources as reported by Zhang *et al.* (2004).

By product of plant origin consist of:

1-Milling industry by products (wheat bran, hulls, corn and germs….ect).

2-By product of oil industry (extracted cakes from ground nut cake, sun flower cakes….ect

3-Byproduct of the sugar industry (molasses, Baggas…ect).(Izeldien2008).

2-3-1-1Sorgham

It is an important grain and forage crop of semiarid regions due to its high adaptability and suitability to rain-fed low input agriculture. It has substantial popularity amongst farmers due to its greater adaptability and various forms of utilization like green fodder, Stover, silage and hay to suit the diverse needs of farming system, besides its grain.(Rattunde et al,2001).

The value of sorghum fodder has increased over the years compared to that of grain. But, one of the major factors limiting the utilization of sorghum fodder is the production of cyanogenic (HCN-producing) glycoside aldhurrin that lowers the nutritive value of fodder due to its toxic effects on the feeding livestock .AlDhurrin is problematic when the digestive enzymes of grazing cattle hydrolyse the compound into hydrocyanic acid (HCN). Leaves and stems of all sorghum species contain hydrocyanic acid or prussic acid (HCN) glycoside dhurrin. Some other plants also produce HCN but in lesser amounts whereas in sorghum it is produced in large quantities (above tolerance threshold) which are hazardous to animal species. The dhurrin is hydrolyzed in the rumen liberating the toxic HCN. HCN or hydrocyanic acid, , can build up to toxic levels (200 □g/g dry weight is the threshold limit, McBee *et al*., 1980) in the leaves of forage sorghum. Hydrocyanic acid can rapidly make cattle ill and doses as little as 0.5 g

Sorghum is used both for grain and forage. While some varieties are grown solely for grain, others have been developed for forage production, and some varieties are dual purpose (Harada et al., 2000).

2-3-1-2 Moringa (Moringa oleifera)

Moringa (*Moringa oleifera* Lam.) is a multipurpose tropical tree. It is mainly used for food and has numerous industrial, medicinal and agricultural uses, including animal feeding. Nutritious, fast-growing and drought-tolerant, this traditional plant was rediscovered in the 1990s and its cultivation has since become increasingly popular in Asia and Africa, where it is among the most economically valuable crops. It has been dubbed the "miracle tree" or "tree of life" in popular media (FAO, 2014; Radovich, 2013, Orwa et al., 2009; Bosch, 2004).

2-3-1-2-1Distribution

Moringa originated from the southern hills of the Himalayas and was introduced in many tropical and subtropical areas, particularly by migrant Asian populations (Radovich, 2009; Bosch, 2004). Moringa seed oil was valued in perfume manufacture Ancient Egypt, Ancient Greece, and thein Roman Empire (Orwa et al., 2009; Bosch, 2004). Moringa is now naturalized in most African countries, in the Caribbean Islands and in Central

America. Moringa is an important crop in India, Ethiopia, the Philippines and the Sudan (FAO, 2014).

Moringa grows from sea level up to an altitude of 600 m but it can be found up to 1000 m in the Himalayas, up to 1350 m in East Africa, and even up to 2000 m in Zimbabwe (Radovich, 2009; Bosch, 2004). Moringa does well where average temperatures are high, ranging from 25 to 30°C. Low temperatures and frost can kill the plant back to ground level but regrowth occurs quickly once the temperatures increase. Moringa grows better where annual rainfall is about 1000–2000 mm. However, moringa is tolerant of drought and survives where rainfall is as low as 400 mm, though foliage production under such conditions is reduced. Moringa has low tolerance of waterlogging. It thrives in full sunlight. Moringa does well on a wide range of soils, with pH ranging from 4.5 to 9, provided they are well-drained (Radovich, 2009; Bosch, 2004). Moringa has some salt tolerance (up to 3 dS/m during germination and 8 dS/m once well established) (Nouman et al., 2014; Oliveira et al., 2009).

India is the main exporter of moringa: canned leaves, fresh fruits (1.2 million t in India), oil and leaf powder (Radovich, 2009). In Africa, leaves are the main product for local trade (EAO, 2004).

2-3-1-2-2Morphology

Moringa is a small to medium evergreen or deciduous tree that can reach up to 10-12 m. It has a spreading open crown, typically umbrella-shaped. The roots are deep. The bole is crooked, generally one-stemmed but sometimes forked from the base. The bark is corky and grey. The branches are fragile, drooping, bearing a feathery foliage. Young twigs and shoots are shortly and densely haired, purplish or greenish white. Moringa leaves are alternate, 7-60 cm long, tripinnately compound with each pinnate bearing 4-6 pairs of leaflets that are dark green, elliptical to obovate, 1- 2 cm in length. The inflorescences are 10-20 cm long, spreading panicles bearing many fragrant flowers. Moringa flowers are pentamerous, zygomorphic, 7-14 mm long and white to cream in colour. The fruit is a typically 3-valved capsule, 10 to 60 cm in length, often referred to as a “pod” and looking like a drumstick (hence the name "drumstick tree"). The fruit is green when young and turns brown at maturity. The mature fruit splits open along each angle to expose the seeds. The capsule contains 15-20 rounded oily seeds, 1-1.5 cm in diameter surrounded by 3 papery wings, up to 2.5 cm long. Moringa seeds contain a large amount of oil (FAO, 2014; Radovich, 2009; Orwa et al., 2009; Bosch, 2004, Foidl et al., 2001).

2-3-1-2-3 Utilization of moringa oleifera

All parts of moringa are consumed as food. The plant produces leaves during the dry season and during times of drought, and is an excellent source of green vegetable when little other food is available (FAO, 2014). Moringa is mainly grown for its leaves in Africa, and much appreciated for its pods in Asia (Bosch, 2004). Leaves, pods, roots and flowers can be cooked as vegetables. The roots have been used as a substitute for horseradish but may be slightly toxic. The leaves are very nutritious and rich in protein, vitamins A, B and C, and minerals. They are highly recommended for pregnant and nursing mothers as well as young children (FAO, 2014). They are generally cooked (boiled, pan-fried) and eaten like spinach or put in soups and sauces. Moringa leaves are eaten as a salad or dried and ground to make a very nutritious leaf powder. Moringa leaf powder is used for the re-nutrition of infants suffering from malnutrition. Moringa flowers are used to make tea, added into sauces or made into a paste and fried. The young pods are prepared and taste like asparagus. Older pods can be added to sauces and curries in which their bitterness is appreciated (FAO, 2014; Radovich, 2009; Orwa et al., 2009; Bosch, 2004). The immature seeds can be cooked in many different ways while the mature seeds are roasted and eaten like peanuts. Moringa seeds contain about 30-40% of edible oil (ben oil) which is used for salad dressing and cooking and can replace olive oil. Ben oil is resistant to rancidity and provides substantial amounts of oleic acid, sterols and tocopherols (FAO, 2014).

Moringa leaves are a valuable source of protein for ruminants but they have a moderate palatability. They are used in smallholder rabbit farming in several African countries. Using moringa leaves in poultry, pigs and fish is feasible but only in limited amounts due to the presence of fibre and antinutritional factors. Moringa oil seed cake, the by-product of oil extraction, is poorly palatable to livestock and mainly used as green manure or flocculating agent in water treatments. Moringa seeds seem to be toxic to rabbits.

Moringa leaves are usually considered as source of protein. However, the protein content range from 15% to more than 30% DM as it depends on the stage of maturity and on the fodder's respective proportions of leaflets, petioles and stems, the latter being much poorer in protein. Likewise, the fibre content of moringa leaves reported in the literature is extremely variable, with an ADF content ranging from 8% to more than 30% DM. Lignin content is also variable, from 2% to more than 10% DM. Moringa leaves contain high levels minerals (about 10% DM), particularly Ca and Fe. Moringa leaves contain high amounts of a wide range of vitamins (ß-caroten, ascorbic acid, vitamin B1, B6 and niacin, FAo,2004) as well as flavonoids (quercetin and kaempferol) which are known to be more potent antioxidants than ascorbic acid ,Moringa leaves may thus be used as an antioxidant feed, Moringa leaves have a relatively high lipid concentration (5-6%, up to 10% DM) with an important proportion (33 to 45%) of α-linolenic acid (C18:3n-3) (Magness, et a, 1971), Moringa leaves are good source of digestible protein, digestible OM and energy for ruminants and therefore a valuable protein supplement. In addition, moringa leaves provide valuable mineral supplementation when minerals are limited or unavailable. The palatability of moringa forage has been reported to be only average. Moringa leaves could successfully supplement low-quality forage diets and improve animal performance. However, when they were included in ruminants diets to replace concentrates (commercial, sunflower meal, soybean meal), moringa leaves could generally not yield similar animal performance.

Moringa leaves are typically fed fresh to ruminants. They can be ensiled, alone or in mixtures with Napier grass or sugarcane to increase the nutritive value of the silage (Mendieta-Araica et al., 2009).

2-3-2-Crop residues and agro-industrial by products

2-3-2-1Groundnut hulls:

Of the several million tonnes of groundnut produced each year, hulls form about 25 percentof the total mass produced and their utilization thus becomes very important. At present in the developing countries the majority of groundnut hulls are either burned, dumped in forest areas or left to deteriorate naturally. Sufficient information is available to use groundnut hull, Hull digestibility is quite low. (Izeldin, 2008).

2-3-2-2By products of oil industry:-

2-3-2-2-1Groundnut cake:

Groundnut cake is generally a safe feed for all classes of livestock. Unlike molasses, the use of groundnut cake has no general limitations in livestock feeding. Groundnut cake has been used as a protein supplement in cattle feeding. However, its low fiber and high protein contents make it an even more valuable ingredient for poultry rations. Thus most groundnut cake consumed internally in Sub-Saharan Africa during the 1970s and the 1980s may have gone to poultry because of rapid poultry development during the period. The main constraint to its utilization is its easy contamination by toxic substances due to bad storage. The most dangerous substance is aflatoxin.

Groundnut is primarily used for its oil and protein, which are major producers of the crop (ACSAD, and AOAD 1981).

2-3-2-3 Byproduct of the suger industry:

2-3-2-3-1Molasess:

Sugarcane molasses is a viscous, dark and sugar-rich byproduct of sugar extraction from the sugarcane (*Saccharum officinarum* L.). It is a major feed ingredient, used as an energy source and as a binder in compound feeds Sugarcane molasses has several important roles in livestock feeding, due to the nutritive, appetizing and physical properties of its sugar content. Molasses is rather difficult to handle because of its viscosity: it is rarely fed directly in its liquid form but instead mixed to other ingredients (Caldwell, 2001).

Molasses can be used as an energy source for livestock, particularly in situations where grains are unavailable or too expensive (Chaudhary et al., 2001). This utilization is common for ruminants, molasses is fed as a supplement to poor quality roughage, during droughts for instance. Sugarcane molasses is used extensively in ruminants, both as a binder for compound feeds or to supply additional energy to the diet (Pate et al., 1989). It is usually mixed to the feed, but it may be sprayed on low quality roughage to improve its palatability and increase intake (Bayley et al 1983).

2-3-2-3-2 Sugarcane baggase (SCB)

Sugarcane baggase (SCB) is a fibrous material left over in sugar factories after extraction of all the juice from sugarcane (Reddy, 2004). It is cheap agro-industrial by-products.

(Ensminger *et al*. 1990) reported that, baggase is high in fiber. It has a low dry matter digestibility – only about 25%. Additionally, its TDN is extremely low, ranging from 20 – 35%. However, baggase has been used effectively as a carrier of molasses, the combination of which yields a relatively high fiber, high energy yield.

(Abu Swar and Darag, 2002) reported that baggase forms about 43.4 – 48.7% of the total weight of the refined sugarcane. The chemical analysis of baggase reveals 47.9% CF and 1.72 MJ/kg DM metabolizable energy (ME).

2-2-3 Nutritional Requirements of Sheep

An adequate diet for optimal growth and production must include water, energy (carbohydrates and fats), proteins, minerals, and vitamins. Under field conditions of particular stress, additional nutrients may be needed. (For detailed nutrient requirements for sheep, refer to the most current *Nutrient Requirements of Small Ruminants*, (susan schoenian 2012) published by the National Research Council.

2.2.3.1 Water

A clean, fresh, easily accessible source of water should be available at all times. As aminimum requirement in temperate environments, the usual recommendations are ~1 gal. (3.8 L) of water/day for ewes on dry feed in winter, 1½ gal./day for ewes nursing lambs, and ½ gal./day for finishing lambs. In many range areas, water is the limiting nutrient; even when present; it may be unpotable because of filth or high mineral content. For best production, all sheep should have their water availability monitored daily during all weather conditions. However, the cost of supplying water often makes it economical to water range sheep every other day. When soft snow is available, range sheep do not need additional water except when dry feeds such as alfalfa hay and pellets are fed. If the snow is crusted with ice, the crust should be broken to allow access. Still, when possible, sheep should have unlimited access to fresh, clean water. (susan schoenian2012).

2.2.3.2 Energy

Ruminants need energy for their life processes. As far as the diet is concerned it is best to consider the useful energy rather than the total or gross energy (GE) (Owen, 1979).

Energy makes up the largest portion of the diet and is usually the most limiting nutrient in sheep diets. Carbohydrates, fat, and excess protein in the diet all contribute towards fulfilling the energy requirements of sheep. Carbohydrates are the major sources of energy. Concentrates (grain) contain starch, which is a rich source of energy. Forages contain fiber or cellulose, which is not as rich in energy as starch. The major sources of energy in a sheep's diet are pasture and browse, hay, silage, and grains. . (Susan schoenian 2012)

Expressing energy requirement and energy values of feedstuffs for ruminants is somewhat more complex because of rumen fermentation and the complexity of interaction between diet and fermentation and products. One example of this complexity is the effect of balance of absorbed VFA on metabolic efficiency if there is a surplus of acetate (C_2) or a deficiency of propionate (C_3), the C_2 energy cannot be utilized in the citric acid cycle reactions of metabolism (Cheeke, 2005).Meeting energy requirements without over or underfeeding animals is one of the producer's biggest challenges. Energy deficiency is the most common nutritional deficiency in sheep. An energy deficiency will manifest itself in many ways. In growing animals, an early sign of energy deficiency is reduced growth, then weight loss, and ultimately death. In reproducing females, early signs of an energy deficiency are reduced conception rates, fewer multiple births, and reduced milk production. (Susan schoenian 2012).

2-2-3-3 .Protein

Ruminant animals require protein in the diet to supply nitrogen (ammonia) and amino acids for intraruminal microbial activity and amino acids for cellular-level tissue metabolism. Protein expressions are defined in Suboptimal protein supply to the microbial population in the rumen results in a lowered fermentation rate, decreased digestibility of food consumed and decreased voluntary intake (Kempton and Leng 1979). Protein requirements in ruminants include protein and/or nitrogen requirements of the ruminal microbial population. Generally, microbial requirements are met at 6-8% crude protein in the diet. Animal requirements range from 7-20% in the diet depending upon species, sex and physiologic state. Normally animal protein requirements are satisfied by a combination of microbial and dietary escape protein As animal protein requirements increase, the animal becomes more dependent on dietary escape protein. (Huston and pinshak, 2000)**.**

Good-quality forage and pasture generally provide adequate protein for mature sheep. However, sheep do not digest poor-quality protein as efficiently as do cattle, and there are instances when a protein supplement should be fed with mature grass and hay, or when on winter range. Therefore, a minimum of 7% dietary crude protein is needed for maintenance in most sheep. Protein requirements depend on the stage of production (growth, gestation, lactation, etc) and the presence of certain diseases (internal nematode parasites, dental disease, etc), (susan 2012).

2-2-3-4. Minerals

Calcium and phosphorus are the minerals required in greatest quantity by beef cattle (Cheeke, 2005).

The net requirements of mineral elements for maintenance plus growth are calculated as the sum of the endogenous losses and the quantity retained. They concluded that, dietary requirements decline less with ages because the availability of these elements is reduced as the animal matures. It should be noted that within small ranges in weight mineral requirements are considered to be proportional to live weight, not to metabolic weight. (McDonalds *et al.*1987).

2-2-3-5- Vitamins

Are organic compounds that must be present at the cellular level to act as catalysts in metabolic processes. As noted earlier, many of the vitamins are synthesized by the ruminal bacteria and subsequently absorbed from the intestinal tract (Huston and Pinchak 2000).

The B-complex vitamins and vitamin K are usually synthesized in adequate amounts in the rumen and vitamin D is obtained with exposure to sunlight. Therefore, vitamin A and E are the major vitamins of concern (Cheeke, 2005). Requirements are often determined from diets containing synthetic sources of vitamins (McDonald et al, 1987).

CHAPTER THREE

MATERIALS AND METHODS:

3-1 Experimental site

The experiment was conducted at the animal production farm department, college of agricultural studies, Sudan University of science and technology (Shumbat).

3-2 Experimental animals and management

12 ewes of hamari sheep with an average weight of 26.58kg were used for the experiment and average age were (1-2) years. Before the start of the experiment, the animals were treated against internal and external parasites. The house was partitioned into three groups well ventilated pens, cleaned, disinfected. The animals were randomly divided into three groups of four animals of each.

3-3 Experimental diet

moringa oleifera was harvested and were chopped into smaller pieces . *Moringa oleifera* leaves were harvested at pre-bloom stage from the Moringa Plantation at the Farm and dried. The dried leaves were ground with hammer mill to obtain *Moringa oleifera* Leaf Meal (MLM).

Three diets were formulated using graded levels of groundnut cake and *Moringa oleifera* leaf meal. The treatment with 100%ground nut cake served as the control diet, which was partially replaced by graded levels of MLM as follows: Diet 1 (0% MLM), Diet 2 (22%MLM), Diet 3 (25%MLM, Other ingredien0ts were incorporated into the diets in the same proportion.

The experimental animals were fed *Sudan grass according* to the body weight as basal feed in all the treatments.

3-4 Feeding Program

The animals were allowed a 10- day adaptation period after which they were offered their respective diets at about (9pm-6am) hours for the four weeks the experiment lasted. Fresh drinking water was provided *ad libitum*.

3-4-1 Table 1: The ingredients of diet1 (control).

control		2300-3616	15	0.5-0.8	19	
	%	Energy	Cp	Ca	fiber	Total/ton
Sorghum	26	858	3.44	0.01	0.64	260
Wheat bran	24.50	613	4.12	0.04	3.14	0
Groundnut cake	12	340	6.0	0.07	1	120
Ground nut hulls	17	294	0.97	0.15	11	170
Lime stone	1.50	0	0	0.55	0	15
Salt	1.0	0	0	0	0	10
Molasses	18	376	0.63	0.11	0	180
Gross	100.00	2.472	15	950	15.956	755
Energy%/cp%						48

3-4-2 Table 2: The ingredients of diet2 concentrate ration with 22% moringa olifera leaf and pots meal.

Moringa22%		2850-4215	12	1.5	19	100
	%	Energy	Cp	Ca	f	
Sorghum	10	330	1	0.1	0	50
Wheat bran	24	600	4	0	3	220
Groundnut cake	5	142	3	0.3	0	0
Moringa leaves	22	601	6	0.31	3	150
Ground nut hulls	10	173	1	0	6	0
Moringa pots	15	391	0	0.15	3	150
Lime stone	1	0	0	0.37	0	10
Salt	1	0	0	0	0	10
Molasses	12	245	0	0.08	0	120
Gross	100	2.482	15	1.08	16.99	660
Energy%/cp%	166					

3-4-3. Table 3: The ingredients of diet3 concentrate ration with 25% moringa olifera leaf and pots meal.

Moringa25%		2850-4215	15	1.5	19	
	%	Energy	Cp	Ca	f	
Sorghum	9	297	1.19	0.00	0.22	90
Wheat bran	24	600	4.04	0.04	3.12	240
Groundnut cake	4	133	2.00	0.02	0.39	40
Moringa leaves	10	173	0.57	0.09	6.45	100
Ground nut hulls	25	683	6.40	0.36	3.65	250
Moringa pots	15	391	0.43	0.14	3.47	150
Lime stone	1	0	0.00	0.37	0.00	10
Salt	1	0	0.00	0.00	0.00	10
Molasses	11	225	0.39	0.07	0.00	110
Gross	100	2482	15	1	17	1000.00
Energy%/cp%	165.30					

3-5 Data Collection

Weight of individual animal was measured at the onset of the trial and subsequently on weekly basis. Feed of known weight was offered and residual weights taken daily to determine total feed intake of animals.

3-6 Chemical Analysis

Dried samples of experimental diets were analyzed. The CP of each of the samples was determined using the automated Kjeldahl method (AOAC 1995). The dry matter was determined by drying in an oven while ash was measured by burning.

3-7 Statistical Analysis

The data collected were subjected to analysis of variance (ANOVA) using the general linear model (GLM) procedure of SAS (1995). Significant differences among means were separated using the Duncan's multiple Range Test (DMRT).

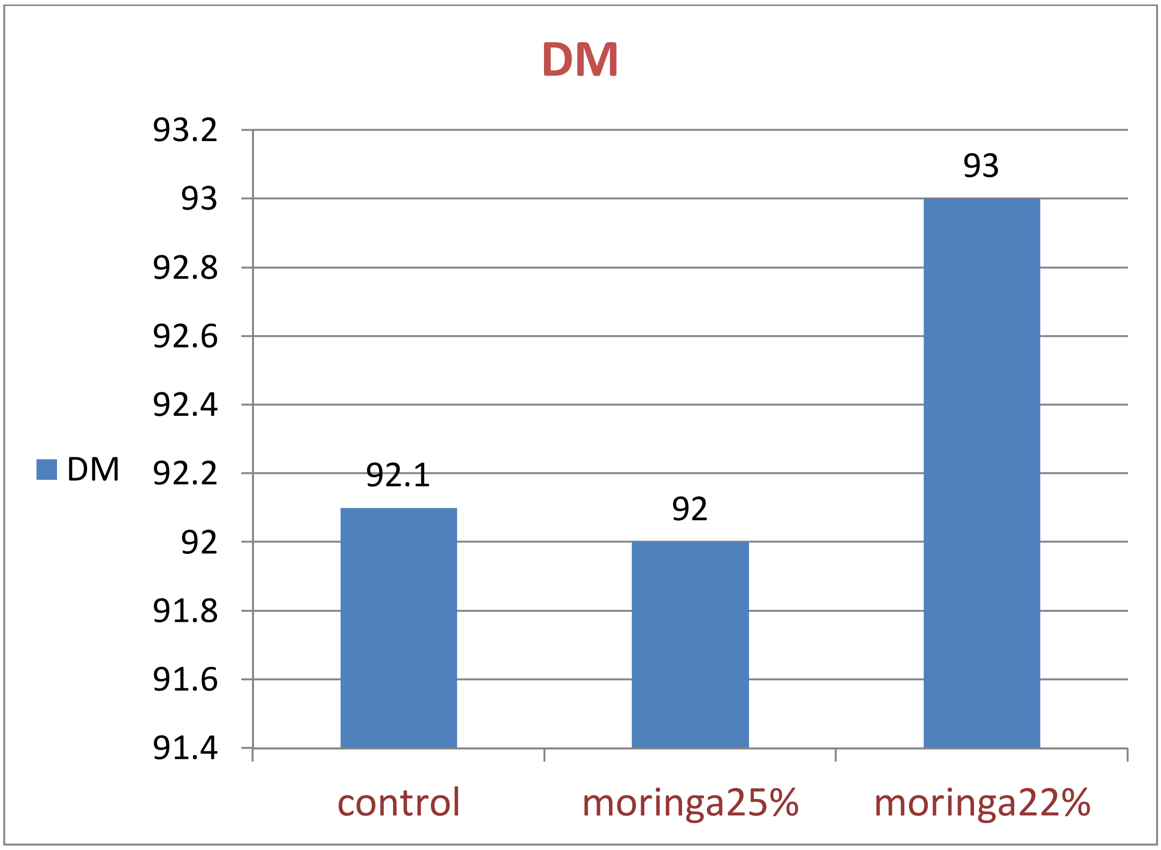
CHAPTER FOUR

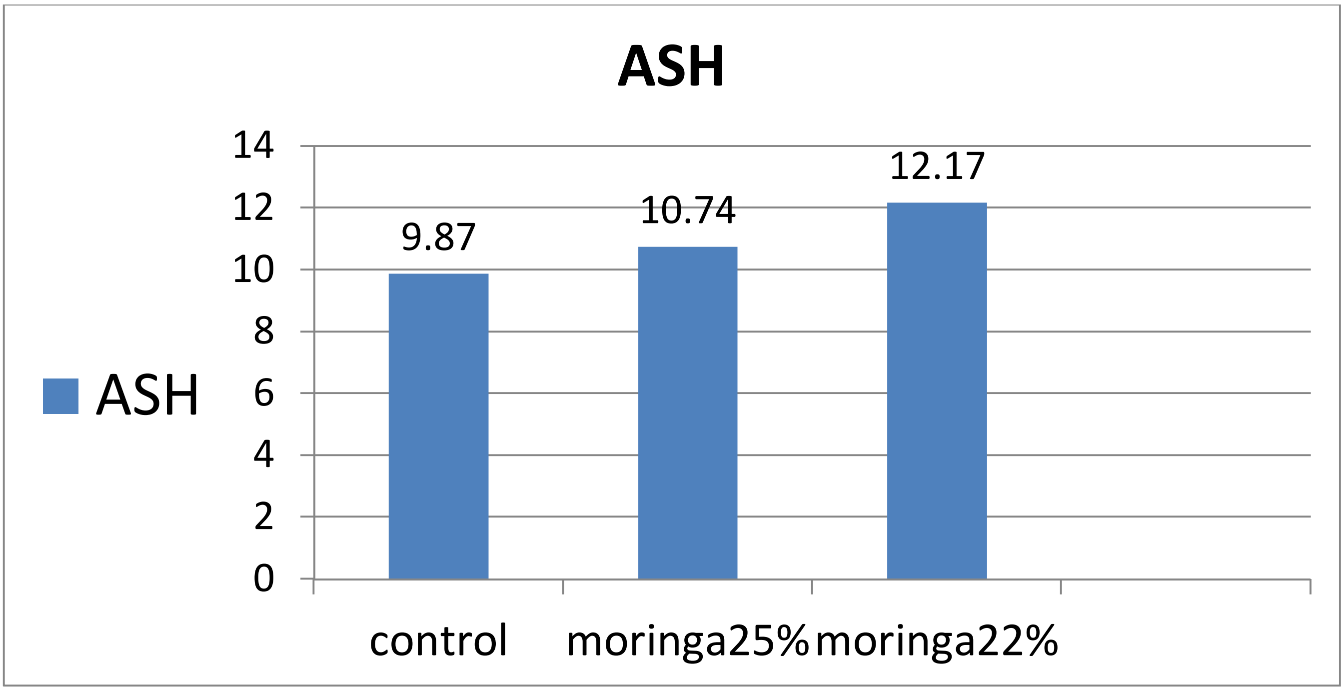
The RESULTS

4-1The comparison of three treatments on the chemical composition of experimental diets:

Table 4. 1: proximate composition of the control diet and moringa olifera (22%-25%).

Sample type	DM	ASH	C.P%	EE	CF	ME/mg/kg
Control	92.10	9.87	20.18	2.80	13.60	7.449
Moringa25%	92.00	10.74	16.28	2.80	15.80	7.322
Moringa22%	93.00	12.17	21.17	4.60	16.60	8.200




ASH
ASH
14
12
10
8
6
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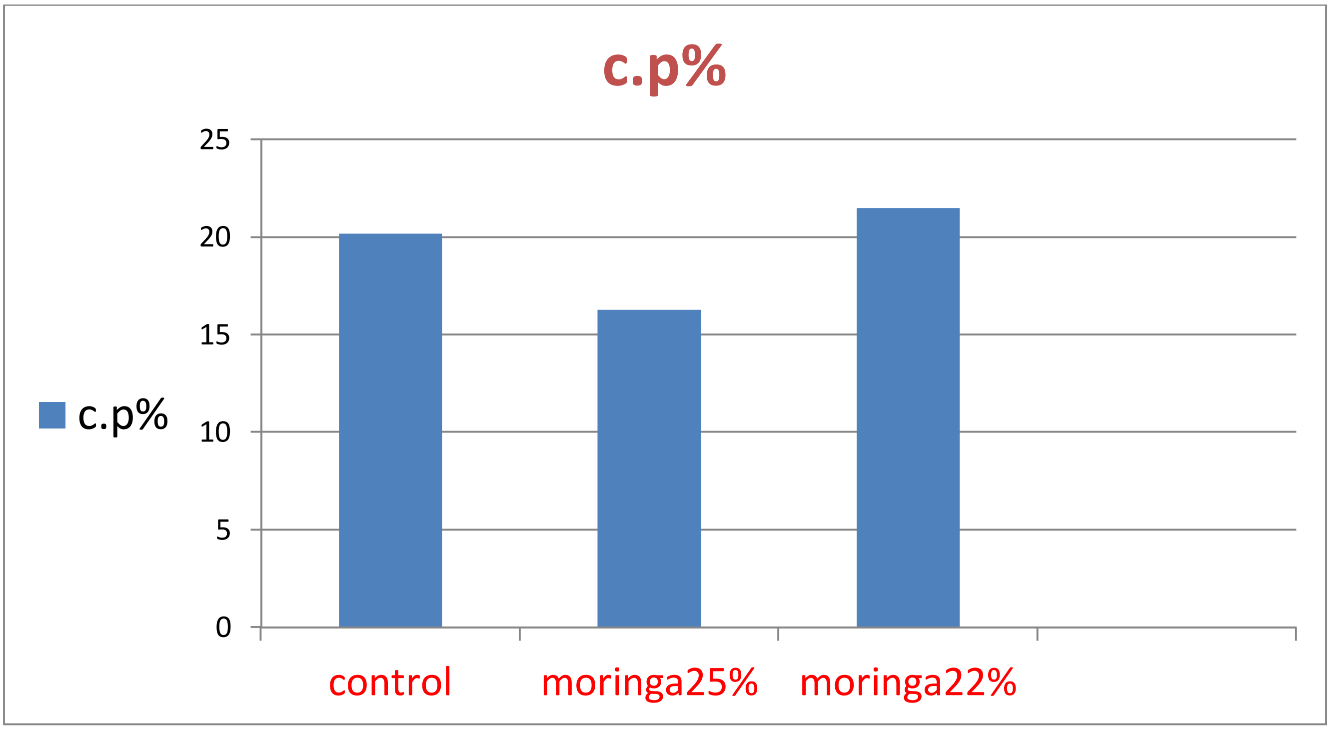
9.87
10.74
12.17
control
moringa25%
moringa22%


c.p%
c.p%
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control
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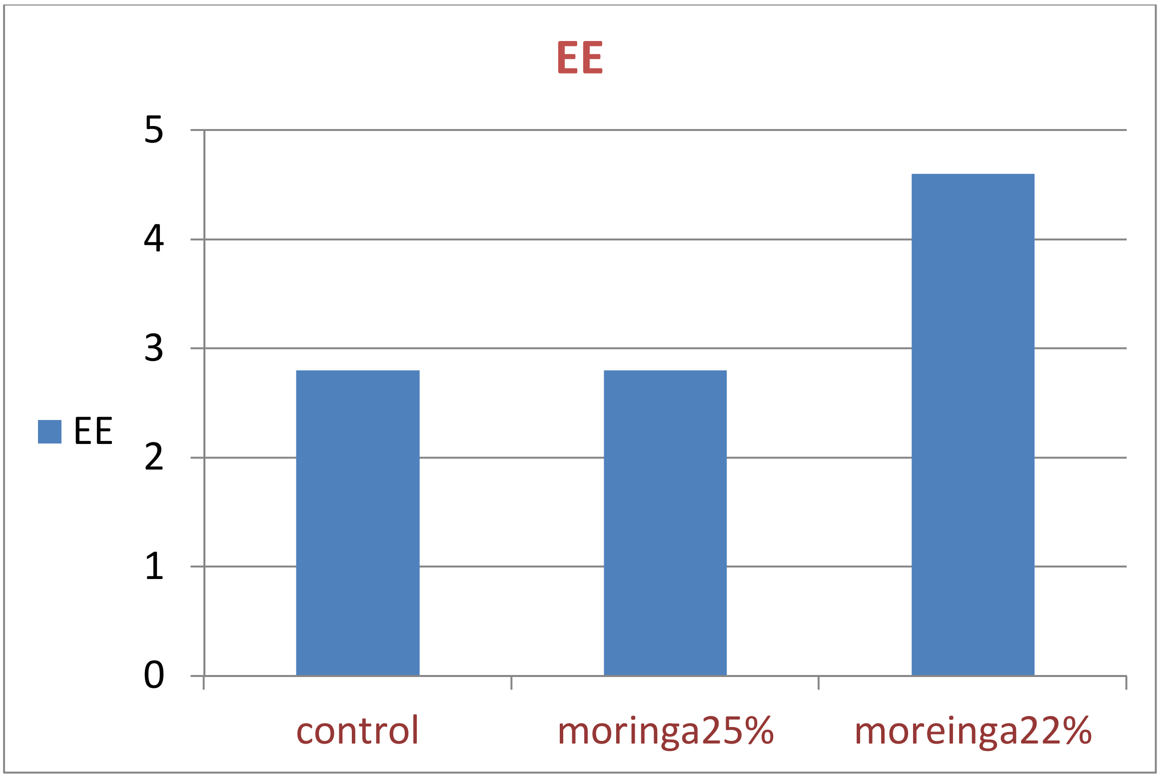
moringa22%


EE
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EE
control
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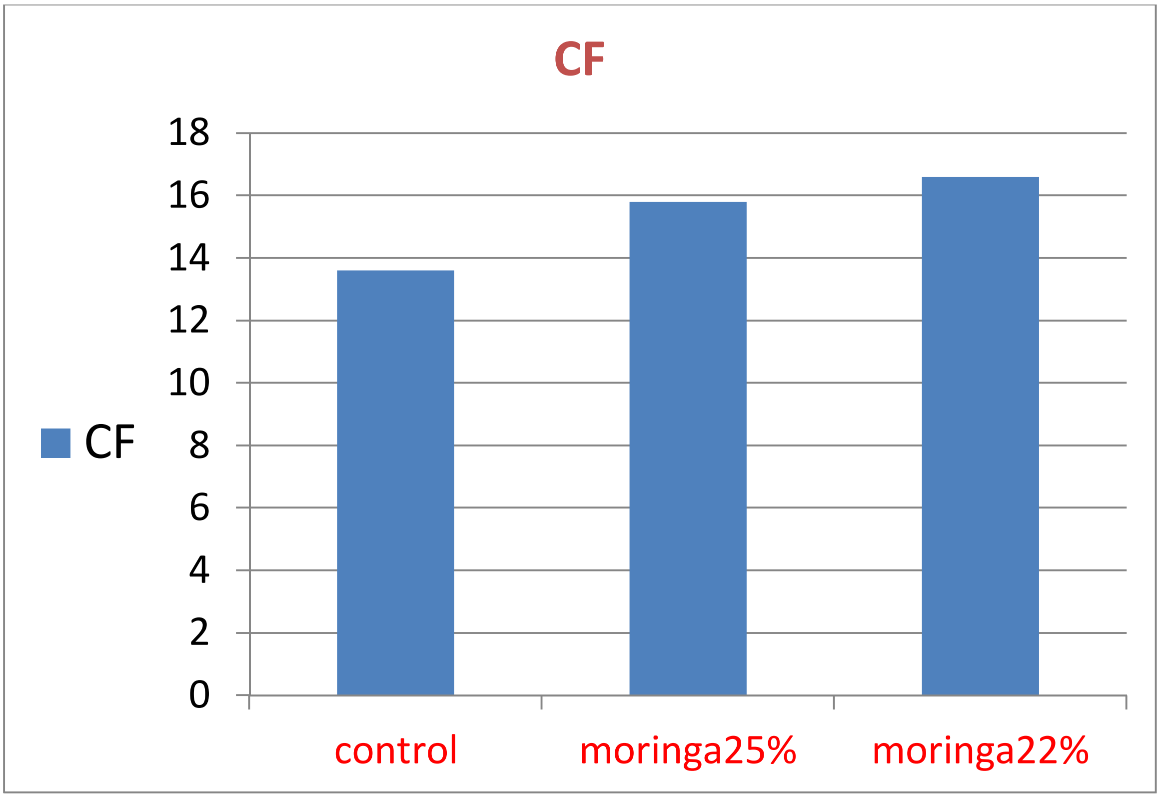
CF
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16
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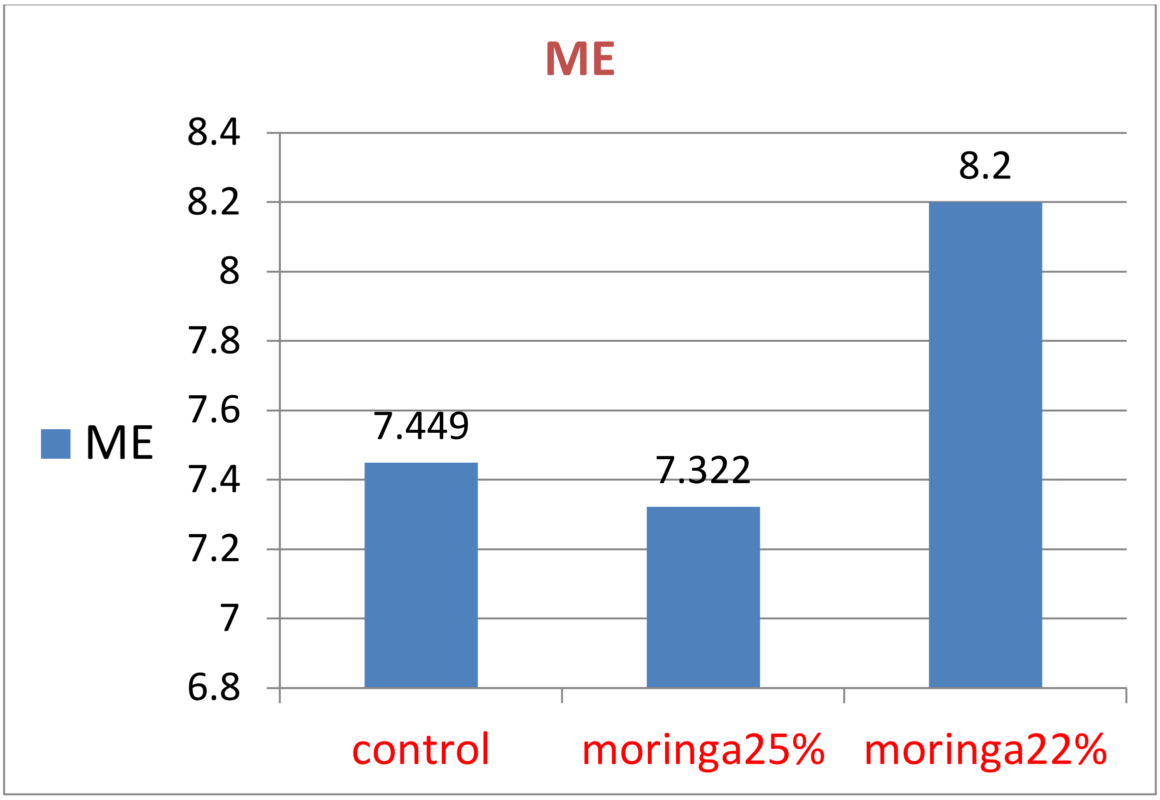
CF
control
moringa25%
moringa22%



As shows in table 1-4 the proximate composition of the control diets. Contained, the cp is 20.13, the crude fiber contents of the diets is 13.60, and Dm were 92.10, the ash values were 9.87, EE were 2.80 , while its metabilizable energy was 7.449MJ Kg. while The CP of graded levels of MLM concentrate was 21.17, 16.28, 21.17 in diets 1 – 2 respectively. The crude fiber contents of the diets were 16.60, 15.80 in diets respectively. The ash values were 12.17, 10.74 in diets 1 – 2 respectively while the metabelizble energy (ME) values were 8.200, 7.322MJ/ Kg in diet 1 – 2 respectively.

Table 2-2 : statistical analysis of diets:

			Sum of Squares	Df	Mean Square	F	Sig.
DM * rep	Between Groups	(Combined)	.007	2	.003	.011	.989
	Within Groups		1.833	6	.306		
	Total		1.840	8			
ASH * rep	Between Groups	(Combined)	.016	2	.008	.005	.995
	Within Groups		9.075	6	1.512		
	Total		9.091	8			
C.P * rep	Between Groups	(Combined)	1.253	2	.626	.086	.919
	Within Groups		43.930	6	7.322		
	Total		45.183	8			
E.E * rep	Between Groups	(Combined)	.027	2	.013	.012	.988
	Within Groups		6.533	6	1.089		
	Total		6.560	8			
CF * rep	Between Groups	(Combined)	.027	2	.013	.005	.995
	Within Groups		14.613	6	2.436		
	Total		14.640	8			
ME * rep	Between Groups	(Combined)	.007	2	.003	.015	.985
	Within Groups		1.363	6	.227		
	Total		1.370	8			

DF: degree of freedom

F: f values

Ls: level of significant

There were significant differences ($p>0.05$) between three group.

4-3: The dry matter intake DMI, crud protein intake CPI , crud fiber intake CFI Ether extract , Ash intake and metabolic energy intake MEI.

Sample type	DMI	ASHI	CPI	EEI	CFI	MEI
Control	1105	118.44	242.16	33.6	163.16	89388
Moringa22%	1116	146.04	254.04	55.2	199.2	98400
Moringa25%	1100.32	128.45	194.70	33.5	119.6	87571.12

*. The mean difference is significant at the 0.05 level.

4-4:The effect of Moringa leaves and pods meal on weight gain:

According to table 4-3 There were significant differences (P>0.05) in body weight gain between treatment groups, Animals in group two (moringa22%) gave the highest weighted gained an average 30.25kg, while animal in group1 (control) weighted gained an average 29.25 kg, while animal in group three(moringa25%) weighted gained an average 27.30 kg.

Table 4: The weight gain of three treatments:

Treatment	**first weight**	**Second weight**	**Third weight**	**Fourth weight**	**Fifth weight**
Control	**26.9**	**28.63**	**28.13**	**28.5**	**29**
Moringa (22%)	**27.38**	**28.63**	**29.63**	**30**	**30.25**
Moringa (25%)	**25.5**	**26.13**	**25.75**	**26.8**	**27.38**

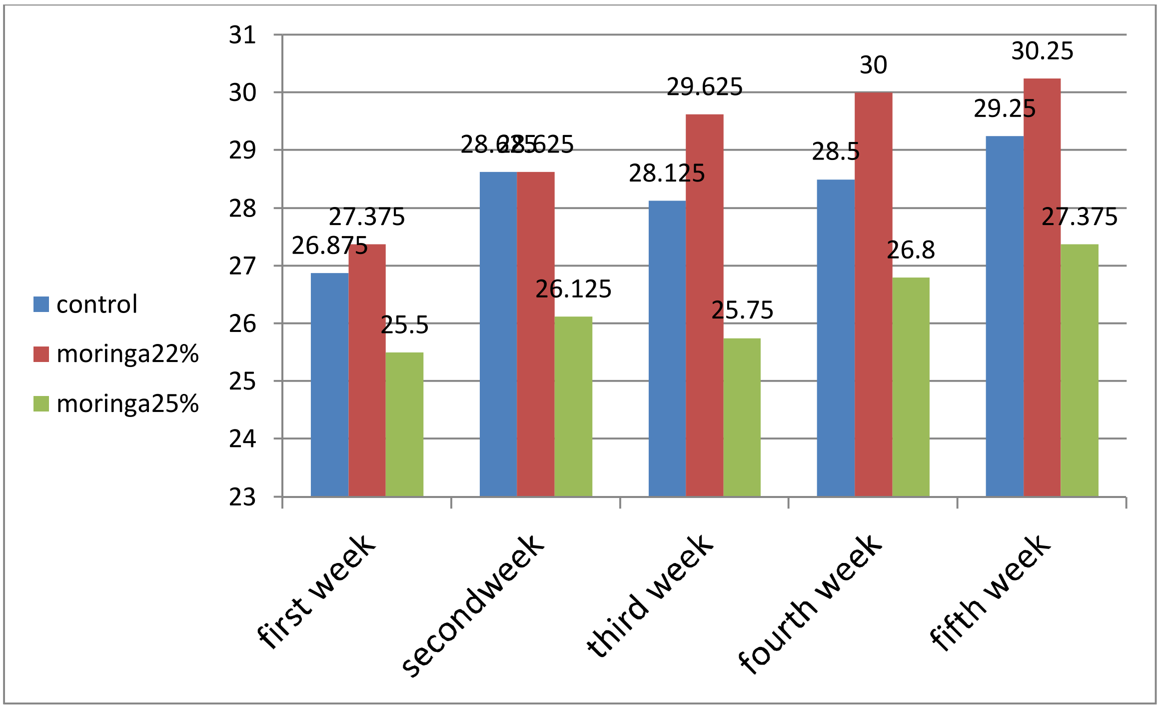


Table 5: Initial weight, final weight, gain/day, total gain, feed conversion ratio (FCR).

Sample type	Initial weight	Final weight	Gain/day	Total gain	FCR
Control	26.9	29.5	400g	3.13	3
Moringa22%	27.38	30.25	500g	3.9	2.4
Moringa25%	25.5	27.38	350	2.12	3.4

Table 4-6 : Analysis of variance of body weight change:

Parameter	**Treatments**			**Level of sig**
	Control	22%molm+ Pod	25molm+ Pod	
Weight gain (kg)	29	30.25	27.38	**

There were significant differences between three groups, moringa (22%) weighted the highest weight gain.

Molm(22%): moringa olifera leaves meal(22%)

Molm(25%):moringa olifera leaves meal(25%)

LS: level of significant

**: high significant

CHAPTER FIFE

DISCUSSION

5. 1 Experiment (1): The comparison of the three Treatments on the Chemical Composition of Experimental Diets:

The crude protein contents of MLM (Moringa olifera leaf meal) used in this study was falls within the range of (15-30) as than reported in literature by (yang, 2006).the ash contents of MLM was higher than7.53as reported by **(**Ogbe and Affiuk, 2011).

The crude protein content of groundnut cake used in this study was lower than the CP of 40g Kg-1 obtained from five different commercial oil mills in Tanzania (Jagadi *et al*., 1989). The nutritional value of groundnut cake is affected by plant variety, geographical source, weather, processing conditions and level of endogenous substances, Sarwatt *et al*. (2004) obtained 32.0, 44.8 and 5.3g Kg-1 per DM of CP, and ash respectively which was similar to that obtained in this study.

Chemical composition of the concentrate diet indicated that MLM had higher CP than ground nut cake). Studies by Pittroff (2006) revealed that protein requirement need not be exceeded because excessive protein impairs performance as energy is required for its removal. The DM of moringa leaves contained in this study was falls within the range of (82-95.6%) as reported in literature(Sarwatt etal 2004).The EE of moringa leaves contained falls with in the range of (5-6%) as reported in literature by (Moyo et al, 2011, Olaofe et al., 2013).

5-2The dry matter intake DMI, crud protein intake CPI, crud fiber intake CFI Ether extract EE and Ash intake:

The quality of various diets is determined by the protein and energy or digestible dry matter (DDM) content, because these are the nutrients most important to livestock performance. (Shanhan, *et al* 1998)

As mentioned in table (2) in this study, The Moringa olifera (22%) recorted highest in DMI, ASH,CPI,EEI,CFI and MEI than moringa(25%) and this be due to greater palatability and higher protein content of the moringa olifera(22%). This is in line with the result obtained by M'hamed *et al*. (1987) that diets with higher protein content increase intake, However, the result is at variance with the work of Tyler *et al*. (1983,) also revealed that back fatthickness decreased ($p<0.05$) with increasing protein intake in boar. The feed intake was not affected by dietary protein intake.

The groundnut cake recorted highest inDMI.CPI,EEI,CFI,MEI and lowest in ASH content than moringa olifera(25%).

4-3 body weight change (Kg):

The highest weight gain obtained in moringa olifera (22%) and this may be due to the different feed intake in all the diets and higher quality (better balanced) and by-pass protein in MLM (Makkar and Becker, 1996). In another study conducted by Ndemanisho *et al*. (2007), average growth rate did not differ in goats fed CSC and MLM based concentrates in rumen fistulated goats. According to Kiran *et al*.(2011), protein should not be overfed but less protein of higher quality.

Conclusion and Recommendations

Conclusion

Moringa oleifera leaves are suitable for feeding sheep. It could be concluded that.

Moringa oleifera leaf meal has been implicated to replace gradually groundnut cake in concentrate supplements fed to sheep with improvement in growth performance without adverse effect. Reduction in the cost of production due to replacement of groundnut cake with *Moringa oleifera* leaf meal will increase profit and better the living standard of farmers.

Recommendations:

- Moringa leaves are good source of digestible protein, energy for ruminants and therefore a valuable protein supplement. In addition, moringa leaves provide valuable mineral supplementation when minerals are limited or unavailable.
- Moringa leaves could successfully supplement low-quality forage diets and improve animal performance. However, when they were included in ruminants diets to replace concentrates (commercial, ground nut cake,sunflower).
- The best utilization to the morniga olifere in the study is olifera not fed moringa more than 22%

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Appendices

Chemical composition of diets of three treatments