Sudan University of Science and Technology

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Effect of using (*moringa oliefera)* leaves Ensilage to improve Traditional Crops Residues

أثر استخدام أورق المورينقا اولفيرا كسيلاج لتحسين بقايا المحاصيل التقليدية

By:

Ebtisam Mohammed Edris

B.Sc. (Animal Production Department), College of Agricultural Studies Abu N`ama University of Sinar, (2007)

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Supervisor:

Dr. Ahmed Khalil Ahmed

College of Agricultural Studies, Department of Animal production- Sudan University of Science & Technology

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Dedication

To my dear family

Father, mother ,brothers

and sisters

To my dear friends and

Colleagues With love and respect

ebtisam

Acknowledgements

My gratitude's are first to Almighty Allah, who supported me and give strength and patience to finish this work successfully.

I am indebted to **Dr. Ahmed Khalil Ahmed** , my supervisor, for his invaluable scientific guidance, suggestions and the time he spent with me in stimulating discussions.

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Abstract

In this study three levels of Moringa olifera plant leaves in 10% , 20% and 30%, were used with traditional agricultural waste (Crop Residues-groundnut shells, groundnut straw (leaves +stems) and pigeon pea (leaves - stems) to make silage .these above levels were stored in three stages through the 30, 40 and 50 days .the statistical design used is complete randomized design. The results analyzed with general liner model using LSD for mean separation between the treatments . the results showed that significant differences ($P < 0.05$) were in the protein content between the treatments of Moringa and between the three levels were higher in 30% (20/13) and followed by 20% (59/12) and the lowest 10% (26/12) and also found significant differences in the protein between storage periods were higher 30 Days (12/15) followed by 40days (18/13) and the lowest in 50 days (75/9) while in fiber, the there are no significant differences in Moringa levels and periods of storage . Moringa can be used high-quality silage attributed to contain a high percentage of protein.

المستخلص

في هذه التجربة استخدمت ثلاثة مستويات من اوراق شجره المورينقا الجافه بنسبة 10%، 20% و30% كسيلاج.أضيفت مع المخلفات الزراعيه التقليدية قشره الفول السوداني و اوراق سيقان الفول السوداني و اوراق اللوبيا العدسي وتم تخزينها علي ثلاثه مراحل 30، 40 و50 يوم تم تحليل العينات إحصائيا بالتصميم العشوائي الكامل وجدت فروق معنويه في تركيز البروتين بين مستويات المورينقا الثلاثة وكانت اعلي في 30%(13/20) وتليها 20%(12/59) وادني 10%(12/26).كما ايضا وجدت فروق معنويه في البروتين بين فترات التخزين والتى كانت اعلي في اليوم 30 (15/12)وتليها في40اليوم (13/18) وادني في اليوم50 (9/75) بينما في الالياف لا توجد فروق معنويه في مستويات المورينقا وفترات التخزين. وجد ان المورينقا يمكن ان تستخدم كسيلاج عالي الجوده نسبه لاحتوائها علي نسبه عالية من البروتين.

CHAPTER ONE

INTRODUCTION

In the tropics, particularly the semi-arid tropical regions, the major constraint to livestock production is low fodder availability. Conservation through ensilage of fodder produced in the rainy season is likely to be the practice adopted by most small livestock holders…..

Silage from forage can be carried out by simple technology using tropical grasses and tree legumes. silage making technology under local conditions is needed very much.

Silage is one of the most important agricultural product used in the feeding animals in the world. Its amount is increasing annually. It is widely used in ruminant nutrition for beef and dairy production. as a component of mixed diets due to its relatively low price.

Groundnut is the main cash crop in many parts of central sudan the nuts are used for oil and the residue after extraction as a protein resource. However, the leaves have not been used to any great extent.

The groundnuts are harvested in April or May, and a second crop is taken in July or August, the harvest period take 2 to 3 weeks .Some farmers dry these leaves, and store them to feed to their animals, although it is difficult to dry the leaves during the rainy season, and ensiling could be a more appropriate method of preservation. Ground nut straw is one of the best agricultural by products in it is nutritive value. It is extensively used for all classes of livestock. The straw has on DM basis 9% crude protein and 61% TDN (ACSAD, and AOAD1981).

Pigeon pea(*Cajuns Cajuns*) varieties has protein content in the range of 23 - 26% (Oshodi et al.,1985).The protein content is comparable with those in other legumes like cowpea and groundnut which have been used in complementing maize. It is rich in mineral quality and fiber content. Pigeon pea grows well in Nigeria but the hard-to-cook phenomenon and the presence of anti-nutrient shave limited its utilization (Nene *et al.*,1990: El- Tabey, 1992) .

Molasses is one of the widely used water soluble carbohydrates (WSC) additives to stimulate rapid increase or dominance of lactic acid bacteria (Humphreys, 1991). Sugar or molasses are used to provide fast fermentable carbohydrates for the ensilage of sugar-limited tropical herbages. Adding 3-4 % molasses achieved improved quality silages in several studies (Tjandraatmadja et al., 1994; Boin, 1975 and Tosi et al., 1995, MUHLBACH, 2000

The need for higher quality silage in tropical areas calls for new solutions using unconventional forage species and, according to Cardenas et al. (2003), the use of tree foliage as a feed for livestock has increased. Tree foliage can be used to obtain silage with higher CP concentrations and offers the possibility to replace conventional concentrates (Cardenas et al.,2003). While there are many agro-forestry species of interest, one of the most interesting trees is Moringa oleifera, commonly referred to as ‘Moringa ’. It is one of the most widely utilized species (Makkar and Becker, 1996, 1997). Moringa is a fast-growing tree which can reach 12 m in height at maturity and yield up to 88 t ha)1 fresh matter (FM) annually when planted very densely for use as a forage. The CP concentration in leaves is about 200–250 g kg)1 DM with a negligible amount of tannins in all fractions of the Moringa plant and high levels of sculpture-containing amino acids (Reyes- Sanchez et al., 2006)

The study objectives were:

1. To increase nutritive value of crop residues.
2. To evaluate silage making from added Moringa oliefera leaves to crop residues: groundnut shells, pigeon pea straw (leaves + stems) and ground nut straw (leaves + stems)
3. To assess the chemical component of the combination of these Residues. Groundnut shells, pigeon pea straw (leaves + stems) and ground nut straw (leaves + stems) as silages.

CHAPTER TWO

LITRETURE REVIEW

2.1. Description of 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, 2009;Orwa et al., 2009; Bosch, 2004).

2.2. Utilization:

2.2.1. Food uses:

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 an 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; Bailey, 2011).

2.2.2. Agricultural uses:

Phythormones extracted from Moringa leaves have been shown to have a growth enhancing effect on various plants, including black gram, peanut, soybean, sugarcane and coffee. Spraying Moringa leaf extract on leaves increases plant production by 20-35% (Foidl et al., 2001).

2.3. Potential constraints:

2.3.1. Moringa leaves:

Moringa leaves have been found free of trypsin inhibitors. Saponin content was relatively high (up to 8%). Moringa leaves and twigs contained limited amounts of cyanogenic glucosides (Makkar et al., 1997). The latter study did not detect glucosinolates in the leaves and only trace amounts in leaves and stems, but later trials using a different method of analysis reported significant amounts of glucosinolates (Bennett et al., 2003; Amaglo et al., 2007; Bellostas et al., 2010). Condensed tannins are absent (Makkar et al., 1997) or in small amounts (Bakhashwain et al., 2010; Moyo et al., 2012). Ethanol-extracted leaf meals were not reported to contain antinutritional factors (Afuang et al., 2003).

2.4. Nutritional attributes:

2.4.1. Moringa leaves:

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) (Price, 2007; Reyes Sanchez, 2004) as well as flavonoids (quercetin and kaempferol) which are known to be more potent antioxidants than ascorbic acid (Yang et al., 2006; Siddhuraju et al., 2003). Moringa leaves may thus be used as an antioxidant feed (Makkar et al., 2007). 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) (Moyo et al., 2011; Olaofe et al., 2013).

2.5. Ruminants feed:

2.5.1. Moringa leaves:

Moringa leaves are good source of digestible protein 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 ruminant's 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).

2.6. Palatability:

The palatability of Moringa is average. Compared to several shrub and tree species in Cuba and Venezuela, Moringa leaves were only moderately consumed by cattle, sheep and goats (Garcia etal.,2008c; Garcia et al., 2008d; Toral Perez et al., 2008). However, when used as sole supplement or included into a concentrate in growing goats diets, the DMI of *Moringa oleifera* leaves was comparable or higher to that of leucaena (*Leucaena leucocephala)* or gliricidia (*Gliricidia sepium)* (Ndemanisho et al., 2007;Asaolu et al., 2012).

2.7. Nutritive value:

Moringa leaves are valuable source of protein for ruminants. Its protein and organic matter are readily digestible in the rumen and/or in the intestine (Makkar et al., 1997; Makkar et al., 1996; Kakengi et al., 2005; Ndemanisho et al., 2007; Gutierrez et al., 2012). However, the available data are highly variable, and *in vitro* and *in vivo* digestibility reported in the literature range from 40 to 80%, possibly due to the large variability in fibre content. Moringa leaves and stems contain low amounts of tannins with no or low amounts of condensed tannins (Bakhashwain et al., 2010; Murro et al., 2003; Sarwatt et al., 2002; Aregheore, 2002;Makkar et al., 1997; Makkar et al., 1996). The levels of glucosinolates found in Moringa leaves were not reported to impair ruminant nutrition (Bennett et al., 2003; Amaglo et al., 2010).

However, Moringa leaves contain saponins, which may impair palatability.

Moringa leaves seem to promote rumen microbial protein synthesis due to the substantial contents of readily fermentable nitrogen and energy (Soliva et al., 2005). Moringa ruminal *in sacco* DM degradability ranging from 82 to 95.6 % have been reported (Garcia et al., 2008d; Ndemanisho et al., 2007; Sarwatt et al., 2004). However, lower values (<70%) were observed in different animal species and different pore size of the nylon bags (Gutierrez et al., 2012; Garcia et al., 2008a). Including Moringa leaf meal had depressive effect on metabolizable energy, OM digestibility and short chain fatty acids in ruminants in Nigeria (Tona et al., 201 3)

2.8. Crop residues:

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 etal. (2002) yield about 22 million tons of dry matter in the sudan. 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 lignocelluloses 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).

2.8.1. Groundnut straw:

The ground nut straw represents the residues of the plant after harvesting the pods. The straw comprises 42% of the plant weight .Average production of ground nuts straw is estimated to be 336 thousand tons annually in Sudan (ACSAD, and AOAD 1981).

2.8.2. Nutritive value:

Ground nut straw is one of the best agricultural by products in it is nutritive value. It is extensively used for all classes of livestock. The straw has (on DM basis) 9% of crud protein and 61% TDN (ACSAD, and AOAD1981) .

2.8.3. Pigeon pea:

Pigeon pea (*Cajanus cajan*) is a locally available, affordable and under-utilized grain legume of the tropics and sub-tropics. Pigeon pea varieties has protein content in the range of 23 - 26% (Oshodi et al.,1985).The protein content is comparable with those in other legumes like

cow pea and groundnut which have been used in complementing maize. It is rich in mineral quality and fiber content. Pigeon pea grows well in Nigeria but the hard-to-cook phenomenon and the presence of antintutrients have limited its utilisation (Nene et al.,1990; El-Tabey, 1992).

2.8.4. Groundnut shell:

Groundnut shell has great potential for commercial use. It is used as a fuel, filler in cattle feed, hard particleboard, cork substitute, activated carbon, etc.

2.9. Principles of ensiling:

2.9.1. The ensiling process:

Silage is defined as "the product formed when grass or other material of sufficiently high moisture content, liable to spoilage by aerobic microorganisms, is stored anaerobically" (WOOLFORD, 1984). Furthermore, ensiling is a process to preserve forage, based on spontaneous lactic acid fermentation under anaerobic conditions (OUDE ELFERINK *et al.*, 2000).

The ensiling process can be divided into four main phases (WEINBERG and MUCK, 1996): The first one is the aerobic phase, which normally takes a few hours. Here, the residual oxygen between the plant particles is reduced by respiratory activity of the plant material and other aerobic or facultative aerobic micro-organisms like yeasts and enter bacteria. Likewise, proteases and carbohydrates of the plant are active in this stage, when pH is still within the usual range for fresh forage between 6.5 and 6.0. After the aerobic, follows the fermentation phase, which starts when silage becomes anaerobic. This period can last several days or weeks, depending on the ensiled material and ensiling conditions. The pH will decrease to 3.8-5.0, if fermentation proceeds successfully and lactic acid bacteria (LAB) become the major micro-organism population, which produce lactic and other acids. In the third stable phase, most micro-organisms of the second phase gradually decrease in quantity. Some acid-tolerant micro-organisms survive in an inactive state and a few proteases and carbohydrates' maintain activity at a low level, such as certain specialized micro-organisms like Lactobacillus buchneri do. Clostridia or bacilli endure as spores. Once the silage is exposed to air, this leads to the last phase, the aerobic spoilage or feed-out phase. Before feeding out, aerobic conditions may occur due to damage to the silage covering, for instance by rodents or birds. The aerobic phase in turn can be divided into two stages: First for the spoilage stage is the degradation of preserving organic acids by yeasts and occasionally by acetic acid bacteria. This induces a rise in pH, which triggers the second spoilage stage, with the beginning activity of deteriorating micro-organisms like bacilli and other (facultative) aerobic micro-organisms like moulds or enter bacteria. Aerobic spoilage occurs in almost all silages when opened, however the extent is dependent on the numbers and activity of the spoilage organisms

2.10. Type of forage ensiled:

Practically any crop may be made into silage, provided it contains an appropriate level of moisture, adequate amount of readily available carbohydrates and adequate levels of other nutrient (MacDonald, *et el*., 1995). The nutritional value of the produced silage is first depending upon the species and stage of growth of the harvested crop and secondly upon the changes resulting from the activities of the plant and microbial enzymes during the storage period (MacDonald, *et al*., 1995).

2.11. Additives

2.11.1. Molasses:

It is the carbohydrate source, used most frequently and is of particular benefit when applied to crops, low in soluble carbohydrate, such as tropical legumes and grasses.

Good silage has been obtained when molasses was applied at rate 3.5% (Bareeba, 1997, Srawatt 1995). However, if the treated silage has a very low dry matter content, most of the carbohydrate source may be lost in the effluent during the first few days of ensilage.

CHAPTER THREE

MATERIALS AND METHOD

3.1. Experimental site:

The experiment was conducted at the Farm of the Department of Animal Production, College of Agricultural Studies, Sudan University of Sciences and Technology

Silage preparation;-

Moringa(Moringa oleifera) leaves groundnut shells, pigeon pea straw (leaves+ stems) , groundnut straw(leaves+ stems) , were harvested from the farm ,and molasses was taken from research center of animal production.

The chemical composition of the ingredient used presented in table one:-

table .(1)

Ingredient	DM	Fat	CP	CF	Ash	NFE
Groundnut shells	94.82	1.51	4.55	67.42	5.67	16.185
Groundnut straw	94.83	2.85	10.53	28.945	20.23	22.155
Pigeon pea straw	94.67	3.145	25.87	21.23	9.945	24.49
Moringa leaves(dry)	95.18	3.25	16.31	28.395	16.11	31.12

All crop residues were either hand cut or with machine, ,nine treatments were prepared from the different proportions of Moringa added with ground nut shells, pigeon pea straw(leaves + stems), ground nut straw(leaves + stems), and added water and molasses in the different storage periods.

3.3 The Treatments:

Treatment (1) 16 kilo grams ground nut shell were soaked in 32
litters of water for overnight, then presse to remove

water, added moringa leaves in rate 10% (1.6) kilograms and added molasses 3% (o.704) grams. The treated material was mixed and stored in plastic bag .which was tightly closed. Sample from the mixure were taken at 30,40 and 50 days for approximate analysis.

Treatment (2) 16 kilo grams ground nut shell it were soaked in 32 litters of water for overnight, Then pressed to remove water. was added with Moringa oliefera leaves the rate 20% (3.2) kilograms and molasses 3% o.768 grams . The treated material was mixed and stored in a plastic bag .which was tightly closed Sample from the mixure were taken at 30,40 and 50 days for approximate analysis .

Treatment (3) 16 kilo grams ground nut shells were soaked in 32 litters of water for overnight, Then press remove the water . added *Moringa oliefera* leaves 30% (4.8)kilograms and added molasse s3% o.832 grams . The treated material was mixed and stored in a plastic bag. which was tightly closed , Sample from the mixure were taken at 30,40and50 days for approximate analysis.

Treatment (4) 11 kilo grams of pigeon pea straw (leaves +stems) added *Moringa oliefera* 10%(1.1)kilograms. Added molasses3%(o.484) grams the measured amount of molasses was dissolved in 6.5 Litters of water to bring the moisture value, between 60 to 65% . The treated material was mixed and stored in plastic bag .which was tightly closed. sample for mixure were taken at 30, 40and 50 days approximate analysis.

Treatment (5) 11 kilo grams pigeon pea straw(leaves+ stems) added *Moringa oliefera* 20%(2,2) kilograms. Added molasses 3% (o.528) grams the measured amount of molasses was dissolved in 6.6 Litters of water to bring the moisture value , between 60 to 65% . The treated material was mixed and stored in plastic bag .which was tightly closed, sample for mixure were taken at 30, 40and 50 days approximate analysis..

Treatment (6) about 11 kilo grams pigeon pea straw (leaves+ stems) added with *Moringa oliefera* 30%(3.3) kilograms. Added molasses 3% (o.572) grams the measured amount of molasses was dissolved in 7.15 Litters of water to bring the moisture value, between 60 to 65%. The treated material was mixed and stored in plastic bag .which was tightly closed. . sample for mixure were taken at 30, 40, 50 days approximate analysis.

Treatment (7) 12 kilo grams groundnut straw (leaves + stems) added *Moringa oliefera* 10% (1.2) kilograms. Added molasses3 %(o.528) grams the measured amount of molasses was dissolved in6.6 Litters of water to bring the moisture value , between 60 to 65% . The treated material was mixed and stored in plastic bag .which was tightly closed. sample for mixure were taken at 30, 40, 50 days approximate analysis.

Treatment(8) about 12 kilo grams groundnut straw (leaves + stems) added *Moringa oliefera* 20%(2.2) kilograms. Added molasses 3%(o.576)grams the measured amount of molasses was dissolved in 7.2 Litters of water to bring the moisture value, between 60 to 65%. The treated material was mixed and stored in plastic bag .which was tightly closed. sample for mixure were taken at 30, 40and 50 days approximate analysis.

Treatment (9) 12 kilo grams groundnut leaves and straw added *Moringa oliefera* 30%(3.6) kilograms. Added molasses 3%(o.624) grams the measured amount of molasses was dissolved in 7.8 Litters of water to bring the moisture value, between 60 to 65%. The treated material was mixed and stored in plastic bag .which was tightly closed, sample for mixure were taken at 30, 40and 50 days approximate analysis.

3.5. Chemical Analysis:

The Crude protein (CP) of each of the samples was determined using the automated Kjeldahl method (AOAC 1995). The dry matter was determined by drying at 65 C for 48hours in the oven while ash was measured by burning further at 500C for 4 hours. The neutral detergent fiber (NDF) composition were analyzed using the method described by. Van Soest et al. (1991).

3.6. Statistical Analysis:

The complete randomized design (CRD) with factorial arrangement (3x3) was used in this study. Dry matter, crude protein, ether extract, Ash ,and crude fiber data were statistically analyzed by the general linear models procedures MSTATC.

Chapter four

The Results

4.1 Effect of different level of moringa olifera leaves on silage.

Table (1)the results indicate that levels of moringa leaves was not significantly (P < 0.05)affected the dry matter DM content of the silage . The results indicated that the level of moringa leaves significantly (P < 0.05) affected the ash content of the resulted silage . the higest value was for 20% (12,87 %) while the lowest on(10,77 %)was for moringa level.

The crud protein content was significantly (P<0.05) affected by level of moringa leves . the 30% level recorded higher value(13, 20%) however, the lowest protein present (12,26%) was at 10% level.

The moringa leves levels was found to be significantly (P< 0.05) .the highest EE value was in 20% moringa level had (3,45) however the lowest EE(2,71) was in moringa level 10% .

The moringa leves levels did not affected the CF content of silage.

Table 4. 1: Effect of different level of moringa olifera leaves of approximate analysis on silage:

Level of moringa	**Approximate analysis**				
	DM	ASH	CP	E E	CF
10%	95. 51[a]	10.77[c]	12. 26b	2.71[b]	26.74a
20%	95.88[a]	12.87a	12.59b	3. 45[a]	27.26a
30%	95.62[a]	11.88[b]	13.20a	3.18[a]	24.89a
L.S	ns	***	**	*	Ns

L.s= Level of Significant

NS=No Significant differences

* = Significant differences

***=highly Significant differences

4.2 The effect of different level of crop residues on silage

Table (2) the results indicate that crop residues was not significantly ($P<0.05$) affected the dry matter DM content of the silage .

According to the data in table (2)the ash content was significantly ($P< 0.05$) affected by the crop residues . The highest ash content was at (12,874 %) in pigeon pea straw while the lowest on(9,926 %)was for groundnut shell.

The crud protein content was significantly $P < 0.05$) affected by crop residues. the pigeon pea straw crop residues recorded higher value(14, 09%) however, the lowest protein present (12,22%) was at groundnut shell crop residuse

Data in table (2) showed the type of the crop residues significantly ($P<0.05$) affected the EE of the silage , the highest EE (4,42) was for groundnut straw, while the lowest EE value (2,04) was found in groundnut shell.

Table(2) shows the affect of crop residues on the CF content of silage. . significant ($P< 0.05$)variation were found in CF content of the three crop residues .the highest CF (30.63)was in groundnut shell, while the lowest value (23.14) was in pigeon pea straw.

Table 4. 2: Effect of crop residues of approximate analysis on silage:

Crop residuse	Approximate analysis				
	DM	ASH	CP	E E	CF
Groundnut shell	95. 88[a]	9.926[b]	10. 22b	2.04[b]	30.63a
Groundnut straw	95.54[a]	12. 723a	13.73a	4. 42[a]	25.11b
Pigeon pea straw	95.58[a]	12.874[b]	14. 09a	2. 87[b]	23.14b
L.S	ns	***	***	***	Ns

L.s= Level of Significant

NS=No Significant differences

* = Significant differences

***=highly Significant differences

4.3 The effect of different storage period on silage

Table (3) the results indicate that storage period was not significantly (P< 0.05) affected the dry matter DM content of the silage .

According to the data in table (1) the ash content was significantly (P<0.05) affected by the storage period .the highest ash content was at 40days while the lowest on (11,30%) was at 50days.

The storage period affected the protein content of resulted silage significantly , the highest value (15,12%) was at 30days while the lowest present (9,75)was at 50days.

Different in three storage period (30days,40days and 50days). The highest EE value was in 50days period while the lowest on was in30days period.

In crud fiber CF analysis the table indicate that, there were no significant difference between the three storage period .

Table 4. 3: Effect of different storage period of approximate analysis on silage:

Storage period	**Approximate analysis**				
	DM	ASH	CP	E E	CF
30days	95.45[a]	11.72[b]	15.12a	2.78[b]	27.34a
40days	95.9[a]	12.50a	13.18b	3.04[a]	26.41a
50days	95.66[a]	11.30[b]	9.75c	3.52[a]	25.13a
L.S	ns	***	***	*	Ns

L.s= Level of Significant

NS=No Significant differences

* = Significant differences

***=highly Significant differences

Chapter Five

Discussion

5.1 Effect of storage period of crop residues with moringa oliefera on the aproxmiat analysis of the silage :

5.1.1 Crud protein

After 30,40 and 50 days of storage the crude protein concentration of the silage in this study increased with an increases level of Moringa leaves in ground nut shells and ground nut straw similar silage elephant grass mixture with Moringa oleifera.

are in agreement with other studies in foliage from fodder trees increases CP concentration silages (Ca´rdenaset al., 2003; Phiri et al., 2007). While pigeon pea straw decreases with increase level of Moringa leaves did no observed a change in crude protein concentration .

5.1.2 Crud Fiber :

Crud Fiber concentration of silage groundnut shells and groundnut straw after 30 ,40,50 days ensiling, similar silage elephant grass mixture with Moringa decreased when the proportion of Moringa was increased. These results are similar to those reported by Phiri et al. (2007).

while pigeon pea straw increasing when increases level of Moringa leaves).

5.1.3.Ash content:

After 30,40,50days of storage the ash content of silage groundnut shells ,groundnut straw and pigeon pea straw mixture with Moringa leaves ,increased with increase levels of Moringa leaves such silage cassava peel mixture with Moringa leaves

This is largely a reflection of minerals content reported for Moringa leaves (Asaulu et al ,2010). This inducts that Moringa silage may serve as a good source of minerals for ruminant diets.

Conclusion and Recommendations

According to the findings of this study, it could be concluded. The CP concentration of silage based on ground nut shells and groundnut straw was substantially increased by increase level of Moringa leves ,In the three storage period.

The present study showed that the inclusion of Moringa leves also has a positive influence on silage quality. while The CP concentration of silage pigeon pea straw was decreases when increases level of Moringa leves . The CF of silage ground nut shells and groundnut straw (leaves + stems) decreases by increase level of Moringa leves. while pigeon pea straw increasing when increases level of Moringa leaves. The experiment showed that added Moringa produces a good silage quality.

Recommendations

1. Its recommend to produce silage in different level of Moringa, but the best levels are 30% from ground nut shells and groundnut straw (leaves + stems).
2. Its recommend to produce silage in different storage period , but the best storage period are 30days whole crop residues .
3. Further investigation is needed to detect making of silage crop residuse mixing with Moringa leaves
4. Further research will be needed to detect the storage period of silage make by crop residues mixed with Moringa leaves to determine its best storage period
5. Encouragement of scientific research to learn more about the nutritional impact of Moringa .

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Appendix

Appendix 1:

Chemical composition of silage

Chemical composition of silage after 30 days

	DM	Ash	CP	EE	CF
Shell+10%	95.60	6.90	8.93	1.2	36.40
	96.66	7.08	9.38	2.00	34.00
Shell+20%	95.60	10.87	12. 50	2.40	27.20
	95.80	10.86	12. 50	2.40	36.40
Shell+30%	94.80	11.18	15.63	2.00	27.40
	95.20	10.92	14.73	2.00	32.00
Pea+10%	94.00	12.34	18.23	2.40	24.80
	94.00	11.27	18.23	2.40	24.40
Pea+20%	95.60	12.76	16.29	2.80	24.80
	95.60	12.97	16.73	2.40	23.60
Pea+30%	96.20	14.63	13.20	4.40	25.60
	96.20	12.05	13.20	4.40	26.00
Straw+10%	94.80	11.70	17.61	2.40	26.40
	94.80	11.39	17.17	3.60	22.00
Straw+20%	96.40	15.97	15.85	2.40	27.20
	96.40	15.35	16.29	2.40	28.00
Straw+30%	94.80	11.60	18.05	4.40	22.40
	94.60	11.20	17.61	4.00	23.60

Chemical composition of silage after 40 days

	DM	Ash	CP	EE	CF
Shell+10%	95.80	10.68	8.87	1.60	25.20
	95.80	10.68	8.87	1.60	24.80
Shell+20%	96.20	10.17	9.55	2.80	28.40
	96.40	10.37	9.55	2.40	28.00
Shell+30%	96.20	10.81	15.63	2.80	27.20
	96.20	10.18	15.63	2.00	26.80
Pea+10%	96.20	13.09	18.59	3.20	29.60
	96.40	13.27	17.31	2.80	30.00
Pea+20%	96.40	13.69	15.63	4.00	24.00
	95.80	12.73	15.63	4.00	24.00
Pea+30%	96.00	12.50	11.44	2.00	24.40
	96.60	12.42	11.88	1.60	24.00
Straw+10%	96.00	12.08	11.72	4.80	28.40
	96.00	12.29	11.72	4.80	20.60
Straw+20%	95.60	17.50	13.02	2.40	27.60
	95.80	17.33	12.59	2.80	26.80
Straw+30%	96.40	12.62	14.89	4.00	28.60
	96.40	12.62	14.79	5.20	27.00

Chemical composition of silage after 50 days

	DM	Ash	CP	EE	CF
Shell+10%	96.00	7.08	4.64	1.20	31.60
	96.60	7.25	5.07	1.60	32.00
Shell+20%	96.00	10.74	7.18	2.80	36.80
	95.80	10.65	8.45	2.80	35.60
Shell+30%	97..00	11.34	8.46	1.60	31.60
	97.20	10.91	8.46	1.60	30.00
Pea+10%	95.00	12.39	11.44	2.40	16.00
	95.20	12.39	10.56	2.40	14.00
Pea+20%	95.20	13,86	11.44	2.80	22.20
	95.60	13.38	11.44	2.80	22.20
Pea+30%	95.25	13.00	11.00	2,80	18.50
	95.25	13.00	11.44	2.20	18.50
Straw+10	95.20	11.13	10.98	4.40	30.80
	95.20	10.92	11.40	4.00	30.40
Straw+20	95.40	11.26	10.98	10,98	23.90
	95.20	11.20	10.98	6.80	23.90
Straw+30	95.80	11.48	10.98	4.60	16.80
	95.00	11.37	10.56	5.60	17.60

Appendix 2

Interaction

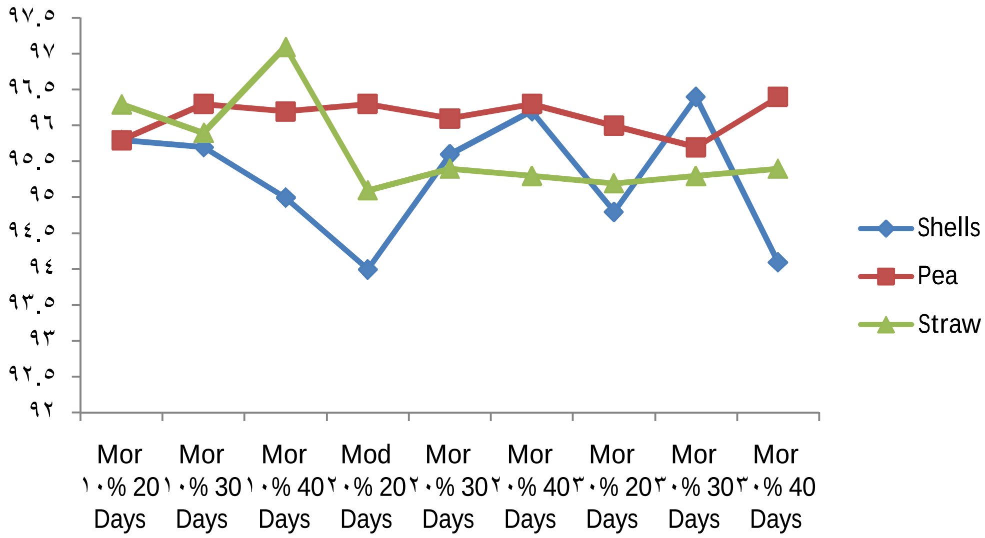

Fig 1. Interaction effect of crop residues with levels of Moringa leaves silage in different storage period on Dry matter DM.

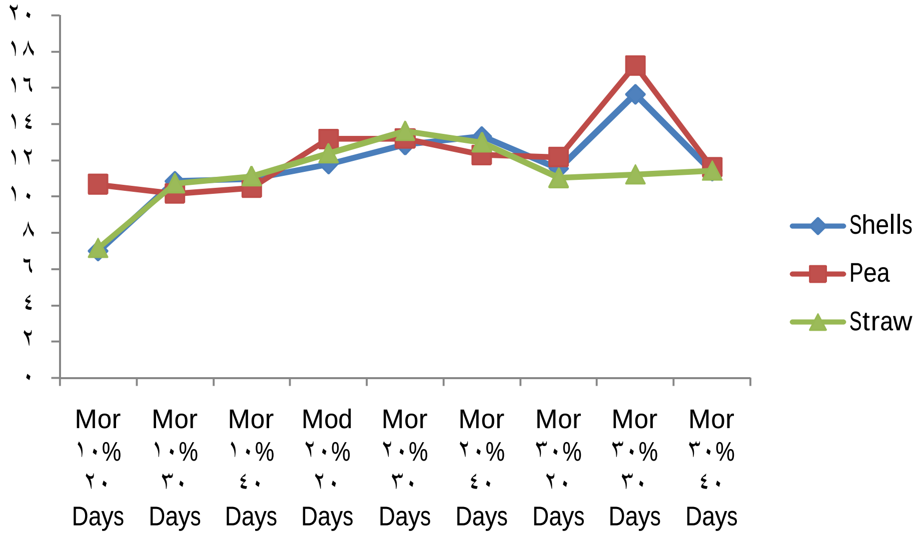

Fig 2. Interaction effect of crop residues with levels of Moringa leaves silagein different storage period on ASH.

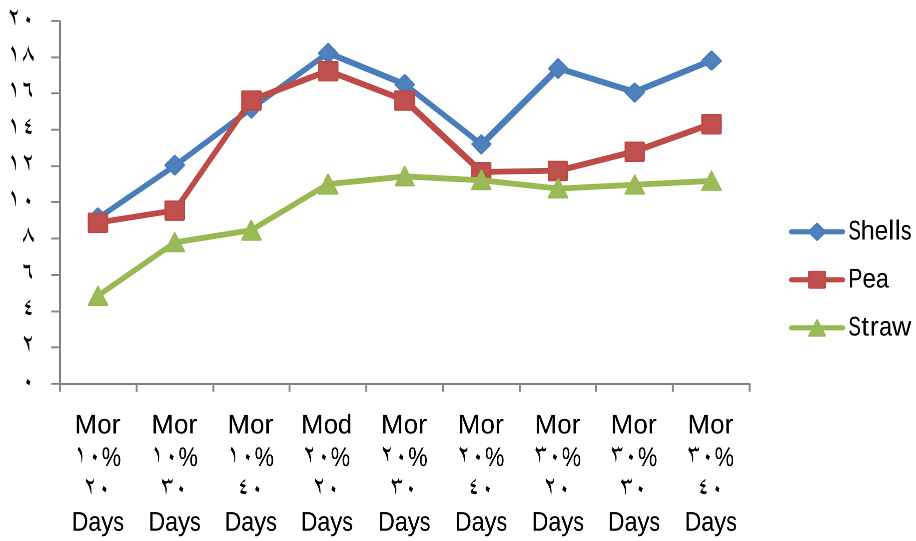

Fig 3. Interaction effect of crop residues with levels of Moringa leaves silagein different storage period on Crud Protein CP .

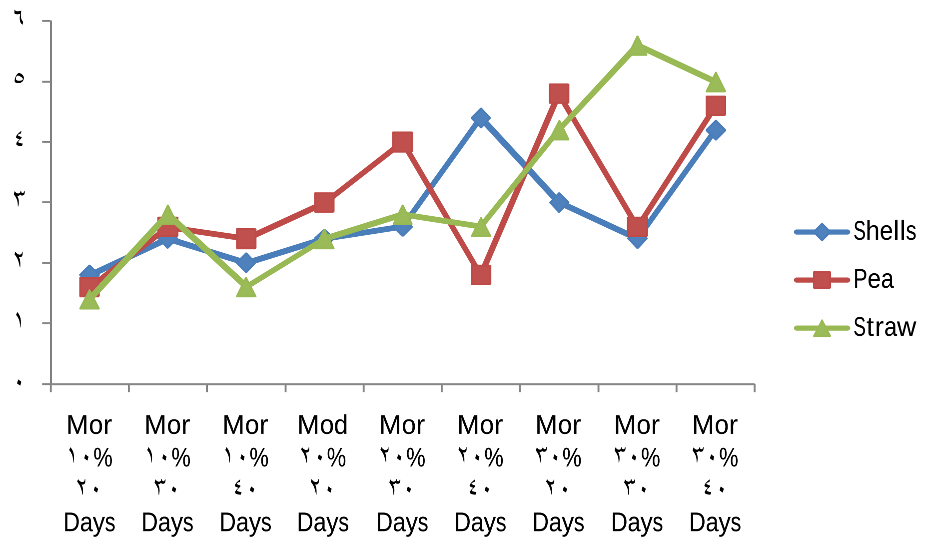

Fig 4. Interaction effect of crop residues with levels of Moringa leaves silage in different storage period on Ether Extract E E

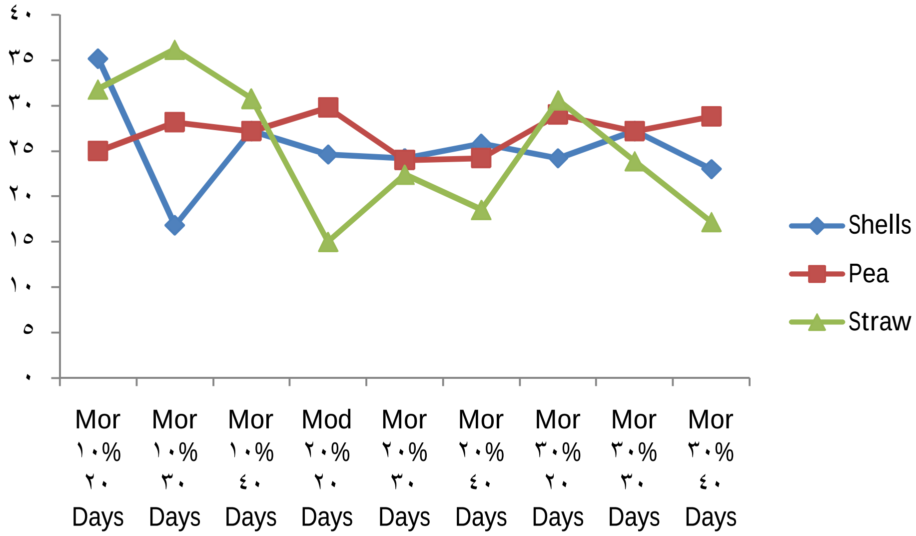

Fig 5. Interaction effect of crop residues with levels of Moringa leaves silagein different storage period on Crud Fiber.

Appendix.3 silage preparation