EFFECT OF MOLASSES AND UREA ADDITIVES ON FERMENTATION AND CHEMICAL COMPOSITION OF SOME SILAGES

By:

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DEDICTION

To my family, mother, father
and brother's to whom I owe my
success in life, I dedicate
this project as a sign of
thanks, appreciation,
respect and love

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I thank God Almighty for giving me the health, strength and courage to accomplish this work.

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ABSTRACT

An experiment was conducted to study the effects of additives on fermentation of bagasse and maize forage silages.

Three types of silage were placed in three different pits. In the first pit there were 250 kg of bagasse, where in the second pits was placed 250 kg of maize. In the third pit 250 kg of mixture of bagasse +maize was used. 18 liters of molasses and 3 kg of urea were added to each pit and mixed. The pits were covered with plastic poly ethylene sheets to enhance anaerobic fermentation for two months.

Samples from each pit were taken after 14 days to measure the pH level. In the bagasse pit the pH was 4.8, where in maize it was 7.45. However in the mixture the pH was 5.56. The level of the pH in bagasse was found to be lower than in maize and the mixture in the same period , This may be attributed to the increase in moisture content of the soaking bagasse .After 49 days it was found that there was no significant differences ($p>0.05$) in pH level among the three samples.

From the results it was observed that the crude protein content increased significantly ($p<0.05$) ,in bagasse from 1.95% to 3.04%.where as in the

maize silage was increased from 6.03% to 10.3%.Crude protein in the mixture was increased from 4.26s% to 7.88%.

There was a significant difference ($p<0.05$) in crude fiber before and after treatment. In bagasse there it increases from 25.99% before treatment to 42.66% after treatment In the mixture the increase was from 28.9% before treatment to 37.37% after treatment, However in maize there was decreased from 35.41% before treatment to 23.41% after treatment .

There was a significant increase ($p<0.05$) in ash content, in bagasse from 3.3% before treatment to 5.58% after treatment. In maize ash content was 8.08% and 8.54% before and after treatment, respectively. In the mixture the range was from 5.9% to 6.57%.

There is a significant difference ($p<0.05$) in ether extract, before and after treatment. In bagasse it decreased from 1.39% before treatment to 1.22% after treatment. In the maize the increase was from 0.86% before treatment to 1.44% after treatment. In the mixture the increase was from 0.9% before treatment to 1.38% after treatment

There was a significant difference ($p<0.05$) in metabolizable energy before and after treatment. In maize the increase in metabolized energy was from 9.73MJ/kg to 10.73MJ/kg In bagasse and mixture it decreased from 11.39MJ/kg to 9.52MJ/kg, and 10.7MJ/kg to 9.77MJ/kg respectively. It has been concluded that addition of molasses / urea has produced good quality silage and that is ascribed to the improved fermentation process with possible high production of propionic acid.

ملخص الاطروحه

ثلاثه انواع من السيلاج كونت فى ثلاثه حفر منفصله الحفره الاولى تحتوى على ٢٥٠كجم من قصب الذره الشامى ' الحفره الثانيه تحتوى ٢٥٠ كجم من البقاس الحفر الثالثه تحتوى على٢٥٠كجم خليط ٥٠% من البقاس ن ٥٠% من قصب الذره الشامى .

تم إضافة ١٨ لتر من المولاس ثلاثه كجم من اليوريا لاى حفره تركت هذه الحفر معزوله من الهواء الخارجى باستعمال اكياس ومشمعات عازله تماما للاكسجين لفترة شهرين لمساعدة عملية التخمر.

تم اخذ عينه من كل حفره بعد ١٤ يوم من بداية التجربه لقياس (الرقم الهيدروجينى) فى البقاس وجد ٤,٨ فى الذره الشامى وجد٧,٤٥ وفى الخليط وجد ٥,٥٦ .

لوحظ ان مستوى (الرقم الهيدزوجينى) فى البقاس منخفض اكثر منقصب الذره الشامى والخليط وذلك يعزى الى الزياده فىالرطوبه فى البقاس المغمور لاكثر من ١٢ ساعه قبل ان يدخل ا لى الحفره .

بعد ٥٦ يوم وجد ان الرقم الهيدروجينى متقارب فى المستوى ولا يوجد اى فرق معنوى بينها، فنجدها فى البقاس ٤,٣٧ وفى قصب الذره الشامى ٤,٣٩ وفى الخليط ٤,٢٩

ايضا وجد فى هذه التجربه تغير معنوى فى المركبات الكيميائيه لهذه المواد بسبب المعاملات التى اجريت.

لوحظ فى التجربه بعد قياس محتوى البروتين الخام قد حصل له تغير معنوى زياده بفعل المعامله فنجد فى البقاس زاد من ١,٩٥ الى ٣,٠٤٤ وفى قصب الذره الشامى من ٦,٠٢٧% ال ١٠,٣% وفى الخليط من ٤,٢٦٣ %الى ٧,٨٧٥% .

المعادن حصل لها تغيير معنوى لوحظت زياده فى نسبتها بعد المعامله فنجد البقاس زاد من ٣,٣% الى٥,٥٨ %قصب الذره الشامى من ٨,٠٨% الى ٨,٥٤ % الخيط من ٥,٩٦ %الى ٦,٥٧ %.

ايضا مستخلص الايثر حصل له تغيير معنوى فى حالة البقاس قد إنخفضت بعد المعامله كانت قبل المعامله١,٣٨٧% وبعد المعامله اصبحت ١,٢١٦ % فى حالة الذره الشامى والخليط وجدت زياده بعد المعامله كانت فى الذره الشامى ٠,٨٥٦ %وتحولت الى ١,٤٤% وفى الخليط تحولت من .٨٥٣% الى.% 1.375

الطاقه الممثله لوحظ فيها تغير معنوى فنجد زياده فى الطاقه الممثله فى حالة الذره الشامى تحولت من .٩,٧٣ميجاجول للكيلو جرام قبل المعامله الى١٠,٧٣مجول للكيلو جرام بعد المعامله ولوحظ نقص فى حالة البقاس والخليط ففى حالة البقاس قبل المعامله ١١,٣٩مجول للكيلو جرام وبعد المعامله .٩,٥٣مجول للكيلو جرام والخليط قبل المعامله ١٠,٧مجول للكيلوجرام وبعد المعامله .٩,٧٧مجول للكيلوجرام.

يمكن الايجاز بلن المولاس مع اليوريا قد حسنت عملية السيلجه نتيجه لتحسين نوعية التخمير ونتيجه لاحتمال انتاج نسبه عاليه من حامض البروبيونيك.

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CHAPTER ONE

INTRODUCTION

Silage making is one of the most important methods of preservation of agricultural crops in the world. It is widely used as a component of mixed diets in ruminant nutrition for milk and meat production because of its relatively low price and relating high nutritive value.

The need for silage comes from the increase in livestock numbers, which cause a devastating effect on the environment through overgrazing the natural vegetation. This will lead to soil erosion, and ultimately to desertification. However, modern technology should be aimed at achieving a balance whereby livestock can increase in productivity, where resource degradation can be avoided or minimize, Hence profitable return for the livestock owner, (Steinfeld, 1998). Technology in the conservation of forages can be used in the wet season to preserve fodder to be used during the dry season. Such operations can be used by small scale dairy farms in the semi-arid regions of the tropics (Duble, 1995).

Feeding silage generally results in improved animal performance. This is due to the increased dry matter.

Brigstocke (1994) reported that since the introduction of milk quotas in the European Union, there has been an enormous increase in grass silage production. It was estimated that in 1992, 50-55 million tones of grass silage were made in UK. This is an increase of 20 million tones since the early 1980.

The nutritional value of silage depends first upon the species and stage of growth of the harvested crop . Secondly it depends upon the changes resulting from the activities of plant enzymes and microorganisms during the harvesting and storage periods . Thirdly it depends upon the type of additives used to improve the quality of silage. (Mcdonald,*et al* 1995).

The main objectives of this study are:

1- To determine the effect of the Anaerobic fermentation on nutrient value of roughage.

2- To study the addition of molasses and urea to silage on the chemical composition of maize and bagasse .

3- To monitor the pH level during ensilage.

CHAPTER TWO
LITERATURE REVIEW

2.1: Silage:

Silage is the material produced by controlled fermentation of certain crops of high moisture content. Ensilage is the name given to the process and the container , if used , is known as silo . Generally any crop can be preserved as silage, although the commonest crops used are grasses , legumes and all cereals , especially maize .

The first essential objective in preserving crops by natural fermentation is the achievement of anaerobic condition . In practice this is done by chopping the crop during harvesting , and rapid filling of the silo and practicing adequate consolidation and sealing . The main aim of sealing is to prevent re-entry and circulation of air during storage . Where oxygen is in contact with herbage for any period of time , aerobic microbial activity occurs and the material decays to a useless, inedible and frequently toxic product .

The second main objective is to suppress the activities of undesirable microorganisms such as clostridia and enter bacteria which produce objectionable fermentation products .

These microorganisms can be inhibited either by encouraging the growth of lactic acid bacteria or by using chemical additives. Lactic acid bacteria ferment the naturally occurring sugars (mainly glucose and fructose) in the crop to a mixture of acids , but predominantly lactic. The lactic acid produced increases the hydrogen ion concentration to a level at which the undesirable bacteria are inhibited .The exact critical pH , at which inhibition occurs , varies with the dry matter content and the buffering capacity of the crop ensile.

Legumes are more highly buffered than grasses and are consequently more difficult to ensile satisfactorily. With grass crops of dry matter content of about 200 g/kg the achievement of a 4.0 pH will normally preserve the crop satisfactorily, provided that the silo remains airtight and free from penetration by rain . Wet crops are very difficult to ensile satisfactorily unless they are either pre wilted under good weather condition or treated with a suitable additive. Similarly crops low in water- soluble carbohydrates, or those which are highly buffered , must also be treated with an effective suitable additive before ensiling.

The nutritional value of the silage produced depends firstly upon the species and stage of growth of the harvested crop, and secondly upon the changes resulting from the activities of plant enzymes and Microorganisms during harvesting and storage periods.(McDonal, *et al.,* 1995).

2.1.1: Types Of Forage Ensiled:

Practically any crop may be made into silage, provided it contains an appropriate level of moisture, adequate amounts of readily fermentable carbohydrates and adequate level of other nutrients.

2.1.2: Preparation of Silage from Forage:

Most crops to be used for silage are permitted to mature or

field dry to a moisture level of 650 – 750 g/ kg (250- 350 g/kg DM).

Silage materials, containing below 250 g/kg DM (over 750 g/kg moisture) have a tendency to form a very sour silage and usually lose considerable amounts of silage juices during storage , involving a considerable loss of nutrients . Silage materials with over 350 g/kg DM do not consolidate well and frequently develop spots of mould during storage as the result of excess entrapped oxygen which allows an aerobic fermentation to occur.

Silage crops are usually chopped into fairly small pieces , which will usually vary from 2.5 cm 3 cm in length .This permits adequate consolidation and facilitates the mechanization of silage handling (McDonal,*et al*., 1995) .

Ground shelled maize, cane molasses, limestone , urea, mineral or organic acids , enzymes or bacteria may be added to reduce fermentation losses, improve silage quality and increase nutritive value .

2.1.3: The Chemistry of Making Silage:

1:Phase one: Forage into silo:

Activity begins as bacteria feed on the contents of damaged (chopped) plant cells.

The final respiration of plant cells produces heat and carbon dioxide. During respiration, the oxygen supply is reduced and carbon dioxide is produced . This establishes an anaerobic condition for the optimal growth of lactic - acid – producing bacteria . The duration of this phase greatly influences silage quality.

2- Phase two: Acid production begins:

Plant cell respiration ends .As lactic acid and volatile fatty acid are formed, the pH decreases, which helps to prevent the growth of undesirable bacteria and fungi.

The number of microbes producing exclusively acetic and butyric acid (volatile fatty ; acids) decreases rapidly as the level of lactic- acid -forming bacteria rises .

3-Phase Three: The Lactic acid produce:

During the first few days, setting of the forage occurs. The seepage rate can increase rapidly, whereby the peak can occur on the fourth or fifth day. Seepage occurs when the plant cells rupture from presser and heating due to plant and fungal respiration .

4:Phase four: lactic –acid- producing bacteria dominates.

Silage is then fermented, beginning 3 –5 days after ensilage .It takes up to 20 days before completion. Phase four determines the success of silage making. The lactic -acid – producing bacteria dominate the silos bacteria population. As the lactic acid content of the silage increases , so does the level of acidity, which slows and stops further bacterial and fungal action . lactic acid production peak 3-15% of dry matter depending upon the substrate and the level of fermentable plant sugar .By the end of phase four , the silage is fermented .

5- Phase Five: Through Feed Out:

When properly ensiled, the silage remains in good condition .where by its low pH prevents further microbial activity . If insufficient acid production occurs during the first four phases , however , the silage may be subjected to break down and attach by un- desirable microbes . Should this occur, the silage biochemistry becomes rather unpredictable.

Butyric – acid – producing bacteria can use not only carbohydrates (sugar) but also lactic acid as food growth . In addition, these butyric – producing clostridia species can break down protein to amino acids, which are degraded to undesirable compounds including non-protein nitrogen (NPN) . This leads to reduction in digestible protein. If this occurs , silage pH increases and causes undesirable fermentations to continue until much of the available energy is gone .

2.1.4: Fermentation:

Silage fermentation can be divided into five phases. The first 3 phases , take place during the first 3 to 5 days after ensiling and determine the success or failure of making good –quality silage . They merge with each other rather than having definite boundaries. The first phase starts with the placement of forage in the silo . Plant cells continue to produce heat and carbon dioxide until they cease respiration and die. Heat and carbon dioxide, produced during this phase , which reduce the air space, will cause anaerobic condition . They are essential for growth of the bacteria which produce organic acids .

During phase 2 , acetic acid is the principal acid produced by the bacteria . As the concentration of this acid increases , phase 3 starts with a gradual increase in lactic acid – forming bacteria . Concurrently , there is a decrease in bacteria which form acetic acid ; because they cannot live in higher levels of acidity . Settling of the forage occurs during the first few days and , if the forage is high in moisture , seepage reaches a peak at the fourth or fifth day .

Lactic acid is the major acid produced during phase 4 , which lasts for 15 to 20 days . When the acidity reaches the desired level , bacterial action is stopped .The events in phase 5 depend on the results of the first 4 phases . If there are enough acetic and lactic acids present in the silage to prevent further bacterial action , and the silo is well - packed and sealed to exclude air from the silage pack , no further changes will take place .The silage will then be properly preserved . However , if the acid level is too low , undesirable bacteria , such as those producing butyric acid , may act on the material , resulting in decomposition and foul –smelling silage . Amino acids and protein may be broken down to ammonia and amines , decreasing further the palatability of the silage .

If air gets into the silage- pack due to poor packing and sealing , excess heat builds up from oxidation , resulting in invisible silage losses . Furthermore , molds that develop after air entry , can use lactic acid formed in phase 4, which lowers the acidity of the silage and allows the undesirable bacteria action described above . This action uses some of the energy in the silage to produce heat thereby reducing the energy value of the silage . (Bath, et al., 1985).

2.1.5: Chemical Change during Fermentation

The chemical changes during silage fermentation are complex. These are the result of plant enzyme activity and the action of microorganisms present in the forage or from other sources . For most crops, dry matter contents of about 350g/kg and a soluble carbohydrate content of 60- 80 g/kg dry basis are considered as near to optimal value for silage making (Pond, et al,1995). The plant enzymes continue to be active for the first few days after cutting while oxygen is available; thus resulting in some metabolism of soluble carbohydrates to carbon dioxide, water and production of heat.

Plant proteins are broken down partially by cellular enzymes resulting in an increase in non protein, nitrogen compounds such as amino acid. Aerobic microorganisms multiply rapidly using sugars and starches as energy sources. They produce mainly lactic acid with lesser amounts of acetic acid and small amounts of formic, propionic, and butyric acid.

The lactic acid rises in well preserved silage to drop the pH to about 4.0 Teller and Vanbelle (1990) mentioned that fermentation process in the rumen can be manipulated with chemical or biological feed additives. Genetic engineering of the rumen micro flora or chemical and physical treatment of feeds. Results of the experiment showed that propionic acid in the rumen and the ratio of acetic + butyric / propionic acid were significantly increased in wilted grass silage compared with un-wilted. Bacteria protein synthesis in the rumen was significantly increased with the wilted silage. The flow of protein and amino acids into the intestine was increased.

2.1.6: Losses of nutrients during ensilage:

In the field, over a 24-hour wilting period, the losses of dry matter are not more than 1-2%; but over periods longer than 48 hour a considerable loss of nutrients can occur depending on weather conditions. This can reach 6% after five days and 10% after eight days of wilting. The main affected nutrients are water soluble carbohydrates and proteins. Oxidation losses result from the action of plant and microbial enzymes on sugars in the presence of oxygen, leading to the formation of carbon dioxide and water (McDonald, *et al* 1995).

In the silo, the oxygen trapped within plant tissues causes a dry matter loss of about 1%. Continuous exposure of forage to oxygen occurs sometimes on the sides and upper surface, leading to the formation of inedible composted material. The losses of dry matter in the surface can reach 75%. In most silos, free drainage occurs and the amount of effluent produced depends largely upon the moisture content and could be increased if the silo is left uncovered, allowing rain to enter. Effluent contains sugars, soluble nitrogenous compounds, minerals and fermentation acids. Crops ensiled with a dry matter content of 150 g/kg result in effluent dry matter losses as high as 10% (McDonald,*et al.*, 1995).

The fermentation losses occur from the biochemical changes especially in soluble carbohydrates and proteins. Dry matter and energy losses arising from the activity of lactic acid bacteria are low. The dry matter losses are expected to be less than 5%, in clostridial and enterobacterial fermentations. The nutrient losses will be much higher than in lactic acid bacterial fermentations (McDonald, et al., 1995).

2.1.7: Microorganisms effect in the silage:

Aerobic bacteria and fungi are the dominant microorganisms found in fresh forage, but as anaerobic condition develops in the silo, they are replaced by bacteria able to grow in the absence of oxygen. These include lactic acid bacteria, clostridia and enterobacteria (McDonald, *et al*., 1995).

2.1.7.1: Lactic acid bacteria:

The lactic acid bacteria are normally present in growing crops in small numbers and usually multiply rapidly after harvesting. They can be divided into two categories.1) The Homofermentative bacteria (e.g. Lactobacillus plantarum, pediococcus Pentosaceus, and Enterococcus faecalis) 2) the Hetrofermentative bacteria (e.g. Lactobacillus brevis and Leuconostoc mesenteroides). When the crop is ensiled, the lactic acid bacteria continue to increase, fermenting the water soluble carbohydrates in the crop to organic acid, mainly lactic, which reduces the pH value. During ensilage, some hydrolysis of hemicelluloses also occurs which may be fermented to lactic and acetic acids

2.1.7.2: Clostridia:

Clostridia are present in crops in the form of spores and only grow under strict anaerobic condition. They can be divided into two major groups. a- the saccharolytic clostridia ferment lactic acid and residual water soluble carbohydrates to butyric acid resulting in a rise in the pH. b- the proteolytic clostridia ferment mainly amino acids to variety of products including acetic and butyric acids, amines and ammonia.

2.1.7.3: Enterobacteria:

The enterobacteria associated with silage (called acetic acid bacteria) are facultative anaerobes and compete with the lactic acid bacteria for the water soluble carbohydrates. They ferment these to a mixture of products including acetic acid, ethanol and hydrogen. They can also decarboxylate and deaminate amino acids leading to the production of large concentration of ammonia. The optimum pH for the growth of these organisms is about 7.0 and they are active only in the early stages of fermentation.

2.1.7.4: Fungi:

Fungi grow as single cells (the yeasts) or as multicellular filamentous colonies (the moulds). Yeasts associated with silages include species of Candida, Saccharomyces and Torulopsis. They play an important role in the deterioration of silage when it is exposed to air. The majority of moulds is strict aerobes and is active on surface layers of silage. Their growth is undesirable because they produce mycotoxins which can be extremely harmful to animals. Species associated with deteriorated silages include Aspergillus, Fusarium and Penicillium.

2.1.8: Bagasse physical and chemical components:

Bagasse is the fibrous residue from crushed cane, similar in composition to wood , except that it has a much higher moisture content , about 50%, compared with as little as 10% in some hard wood.

The other components of bagasse are a complex of pentoses, ligin and cellulose. On a dry weight basis bagasse has more pentosans, less ligin and much the same cellulose contents as wood (Ahmed, 1996).

Paturu (1982), pointed out that the moisture content of bagasse in general was between (46-52 %), of fiber (43-52%) and of soluble solid

(2 - 6%).Blackburn (1984) reported that the pH of sugar cane (bagasse) in general was between 4.9 and 5.5.

2.1.9: Molasses:

Paturau (1982) and EL-Hassan (1989) stated that final molasses, known as mother liguor or black strap, contained some sucrose which could not be recovered by economic means. Some sucrose was found to be hydrolyzed into reducing sugars .Similarly starch was gelatinized and partially hydrolyzed by enzymes present in the juice.

The quantity of molasses, produced in proportion to the sugar recovered, was found to be influenced by certain non- sugars in the juice, notably mineral salts and nitrogenous substance. The yield of recoverable sugar decreased while that of molasses increased noticeably (Ruter, 1975 and Mohamed, 1987).

> Dekker, (1957) conducted a detailed examination of molasses from several factories and found that , sucrose ranged (32-36%), reducing sugars (20-30 %), gums including starch (3.55%) crude protein (3.21%), wax(0.45%) , carbonate ash (11.5%) (and moisture (20%).

Similar percentage was shown by Ahmed (1996) who determined the chemical composition of New Halfa molasses:Brix(89.11),Pol9(32.58), purity (30.56%), reducing sugar (14.17%), total sugar (47.13 %), nitrogen (0.35%), protein (2.19%) carbonate ash (11.03%), sulphated ash (14.43%) moisture (20.17%) pH(5.34%) and relative viscosity (3.91 %) .

2.1.10: Maize Silage:

Maize silage is the most popular feed in the world because of its maximum yields of digestible nutrients per unit of land and the plant can be handled mechanically at a convenient time of the year. Well-made maize silage is very palatable and has a moderate to high content of digestible energy , although it contains much grain up to 50% in well – eared crops (Pond, et al., 1995).

Additionally, it is lower than legume forages in most mineral elements, particularly calcium and manganese. (Bath, *et al*., 1985).

DM%------------ 32

Crude protein g/kg DM ---------90

D- value-----------------------------75

ME(M j/kg DM) -------------------11.2

MAD fiber g/kg--------------------220

Ammonia N(% of total N)--------8

pH----------------------------4.2

Fiber g/kg DM--------------------------400—450

Starch g/kg DM -------------------------200—250

Sugar g/kg DM -------------------------10—50

Organic acids g/k g DM -------------------80—120

Calcium g/kg DM------------------------3.8

Phosphorus g/kg DM---------------------------- 2.7

Magnesium g/kg DM------------------------------1.3 (Brigstocke , 1994) .

2.1.11: Advantage of ensilage:

1. Ensiling is much less dependent on fine weather than other means of conserving forage.
2. Maintains feed in a succulent form because silage never loses its water.
3. Reduced fire hazard.
4. No losses from shattering, leaching or bleaching.
5. The risk of infection from internal parasites is smaller with silage than with pasture.
6. Ensilage permits the early re- use of land.
7. Facilitates the complete mechanization of forage harvesting, and feeding.
8. More TDN per acre. When only the grain of a crop is harvested, up to one – half of the TDN is left in the field.
9. No waste in feeding. Even the cobs, shucks, and coarsest stems are eaten.
10. Even weedy crops make good silage. (Brigstocke, 1994).

2.1.12: Disadvantages of ensilage:

1. Considerably costly equipments are required for the harvesting, storing, and feeding of silage.
2. Extra labor required at the silo – filling time.
3. Necessitates handling of considerable volumes of water as a part of the silage material.
4. Not well suited for intermittent use. (Brigstoke, 1994).

2.2: Types of Silos:

A silo is an airtight to semi-airtight structure designed for the storage and preservation of high moisture feeds. Silos are of several types.

2.2.1: Horizontal:

2.2.1.1: Trench:

There are many different sizes, mainly ranging from 10-20 feet in depth, 15-20 feet in width and 100-300 feet in length. They are usually narrower at the bottom than at the top to facilitate effective packing of silage material. The floor is usually concreted in order to avoid the problem of mud sticking to the silage as removed. It is sloped toward downhill end to permit drainage. When the silo is filled, the silage is covered with heavyweight polyethylene sheets which are kept down and held in place with soil, boards, posts, old tires, or some other materials.

2.2.1.2: Bunker:

This type is sometimes used on very flat , rocky , and on soil not well suited for trench silos. The side walls are usually made of posts and boards lined inside with building paper or plastic film. The floor is concreted, with the end left open.

A bunker silo can be used in the same manner as a trench silo, but the main difference being that the former is above the ground and the later below the ground level.

2.2.2: Vertical or Upright (Tower silos):

All upright silos are cylindrical in shape, and ordinarily equipped with a series of doors up one side of the silos, and these are closed as the silo is filled and opened as the silo is emptied .

2.2.2.1: Conventional upright (Semi-airtight):

Most present conventional upright silos are constructed of reinforced poured concrete or concrete staves. Conventional upright silos vary greatly in size ranging from about 12-20 feet in diameter and 40-80 feet in height. This type of silo is normally unloaded from the top using a mechanized un- loader. For an effective preservation of silage in a conventional upright silo, the silage should contain from 25-35% dry matter.

2.2.2.2: Airtight (Sealed) silos:

They are constructed of protected metal with rubber – cemented joints or of monolithic concrete. They vary in size from about 12-24 feet in diameter and 40-100 feet in height. Forages varying in dry matter content (about 25-75 %), may be effectively preserved and stored in an airtight silo.

2.3: Silage Additives:

Silage additives have been in use for a very long time (Owen , 1986) , but it is only in the last 15 to 20 years that the availability of machinery , knowledge of silage fermentation processes, grassland management practices and awareness of the value of forage in the ruminant diet have contributed to the significant growth in additive usage . Jones (1994) observed that over 130 silage additives were available in UK. Over 50 million tones of silages were produced in 1994, but only about 18 million tones of these silages were treated with silage additive.

Owen (1986) summarized the factors which may be regarded as important characteristics of silage additive and reported that silage additives should produce a high quality stable silage with no secondary fermentation, which would improve animal performance . The silage additives should also be non- corrosive to machinery, and easy and safe to handle . Finally , the silage additives should be well-proven and backed by major company .

Additives are used to improve silage preservation by ensuring that lactic acid bacteria dominate the fermentation phase .They can be divided into three general categories: 1) fermentation stimulants, such as bacterial inoculants and enzymes, 2) fermentation inhibitors such as propionic, formic and sulphuric acids and 3) substrate or nutrient sources such as maize grain , molasses, urea and anhydrous ammonia (Woolford, 1984; Henderson, 1993 and Bolsen et al., 1995) .

A number of trials resulted in the conclusion that only strong acids , either alone or in combination with formaldehyde , have the potential consistently to modify fermentation (Thomas and Thomas,1985) . However, these additives have largely lost popularity due to both cost and handling difficulties on the farm . Bacterial inoculants have inherent advantages over other additives, due to their low cost , safety in handling , a low application rate and no residues or environmental problems . However , results of their application are variable , probably due to the differing ensilage conditions prevailing at the time of application . However , when the additives are applied together with enzymes, which degrade plant cell walls and starch providing addition sugars for fermentation to lactic acid. They appear to have achieved improvement in fermentation and nutritional quality of tropical grasses and legumes (Bolsen ,1999). Studies an KiKuyu grass silage , however , suggested that the grass needs to be rapidly wilted before any inoculant is added to achieve improved fermentation, (de Figueiredo and Marais,1994) .There was no improvement when inoculants were added to un wilted grass.

In a comparison of maize meal with a commercial silage additive (containing bacterial inoculant and enzymes), Mhere et al. (1999) found however that when added to the mixture of sorghum/legume and pennisetum /legume , maize meal (5 % of biomass) improved dry matter. Both additives improved the nutritional content but had no significant effect on fermentation quality. This may be accounted for by the fact that silages were stored in small sealed silos where, since the effluent was retained in the silage ; there was no benefit to fermentation of the addition of either additive.

On small scale farms, commercial additives, which comprise inoculants and enzymes, may be too costly. It is likely therefore that the third category of additive will be of most benefit to silage made in small holdings. Possibly the most important benefit of additives such as maize or sorghum grain or cassava meal improved dry matter in early cut crops when moisture content is high where rapid drying (wilting) is not possible or effluent is lost to the silage through seepage . Tropical grasses have been successfully ensiled when supplemented with maize meal (Onselen and Lopez, 1988) cassava meal (Panditharane et al., 1986) and sorghum grain (Alberto et al., 1993).

Molasses is the carbohydrate source used most frequently and is of particular benefit when applied to crops low in soluble carbohydrates such as tropical legumes and grasses. Good silages have been reported when molasses was applied at 3-5 % (Bareeba,1977; Sawatt, 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 in pits or bunkers.

Applying urea or anhydrous ammonia to silages has an adverse effect on fermentation and nutrient quality of silages, particularly high moisture forage sorghums (Bolsen,1999); contrarly Sarwatt (1995) obtained good silage by applying 0.5% urea to maize , sorghum and Rhodes grass in Tanzania. An additive with a urea / molasses blend is possibly the best combination to apply to tropical grasses if they are cut in early vegetative stage (Bolsen ,1999) .El khidir and vestergaard Thambsen (1982) showed that anaerobic incubation of molasses and urea with hay lead to high production of propionic acid . That may explain the production of good quality silage reported by (Bolesn,1999) by addition of molasses and urea i.e. high production of propionic acid during the fermentation process. More research is needed in this filed , particularly in the ensilage of tropical grasses in natural pasture .

CHAPTER THREE

MATERIALS AND METHODS

3.1: Experiment Site:

The present study was done in ELHAJ – YOUSIF area (Elmygoma – parlour 3).

The experiment was started in April up to June (2004).

3.1.1: Silage Preparation:

Three pits (2*1.5 m and 1.5 depth) ,were prepared for ensiling of the silage .In each pit a small drainage ditch was dug in the center to accumulate the sewage . The bottom and sides of the pit were covered with plastic covers , while the top of was ensiled using heavy metals .

3.1.2: Silage Making:

Three types of silage were prepared. In each pit, three kilos of urea and 18 litres of molasses were added.

3.1.2.1: Maize Silage:

Maize with moisture (76%), which was used for silage making was harvested in April 2004

And chopped to about 2.5—3 cm long. 250 kg of maize were ensiled in the pit.

3.1.2.2: Bagasse Silage:

250 kg of bagasse, obtained from ELgenid factory, were used for silage making. Firstly, bagasse was soaked for over- night , then it was squeezed in order to drive out the water .

3.1.2.3: Mixture Silage (maize and bagass):

125 kg from each (maize and bagasse) were used for mixture silage preparation .

3.1.3: Sampling:

3.1.3.1: pH samples:

pH was measured after 15 days of ensilage . It was then measured weekly up to 60 days.

3.1.3.2: Sample for Chemical Analysis:

After 2 months 1kg of each type of silage was taken to be analyzed for crude protein , crude fiber , Ash , either extract (E-E) , and moisture contents, using the AOAC (1984) method.

3.3 Statistical analysis:

The data obtained from the experiment were subjected to analysis of variance using SPSS computer programme .Means were examined for significance by Duncans multiple range tests.

Chapter Four
Results and Discussion

4.1: Chemical Composition:

4.1.1: Dry Matter :

Table (1) illustrates the difference in dry matter between treated and untreated ingredients (bagasse, maize and mixture bagasse+maize) . There are significant difference ($p<0.05$) between them . The mean value of DM of untreated bagasse, maize and mixture , were 97.44%, 23.33% and 60.3800% respectively.

These results showed that DM of treated bagasse ,maize and mixture were lower than the untreated ones. It was 32.34%, 22.33% and 25.94% for treated bagasse maize and mixture respectively.

In this study the DM of bagasse silage 32.34% was higher than that reported by (AFFRCs 1999), who found the DM of bagasse silage was 24.8% .

Also in this study the DM of maize silage 22.33% was lower than that reported by (Brigstocke,1994), who found the DM of maize silage was 32.%.

Table 1. Mean values of Dry Matter Content of untreated ingredients and treated silages .

Ingredient	Before treatment	After treatment	SE
Bagass	97.5%aA	32.3%bA	0.03
Maize	23.3%aC	22.3%bC	0.20

Mixture (Bagasse+ Maize)	60.4%aB	25.9%bB	0.02

A,B,C

Mean values in the same column having different superscripts were significantly variable ($p<0.05$).

a, b, c

Mean values in the same row having different superscripts were significantly variable ($p<0.05$).

4.1.2-Crude protein:

Table (2) illustrates the difference in crude protein content between untreated and treated (bagasse, maize and mixture[bagasse+maize]). The mean values of crude protein of bagasse+maize and mixture were 1.95%,6.03% and 4.26% respectively.

This results showed that crude protein of treated bagass , maize and mixture are higher than the untreated ones, 3.04% , 10.31% and 7.88% for treated bagasse, treated maize and mixture respectively .

In this study the crude protein content of maize silages was higher than that reported by (Brigstocke 1994), who found the protein content of maize silage was 9% while in this study was 10.31% .

These results were in a agreement with finding that reported by Intesar (2003), who found the crude protein of untreated bagasse was 1.7%.

In this study the crude protein content of bagasse silage was lower than that reported by (AFFRCS 1999), who found the protein content of bagasse silage was 5.7%.

It was observed that maize after treatment was significantly higher $(p<0.05)$ than untreated maize.

Also the crude protein of bagasse after treatment was higher $(p<0.05)$ than the untreated bagasse.

Table 2: Mean values of crude protein content of untreated ingredients and treated silages.

Ingredients	Before treatment	After treatment	SE
Bagasse	1.95%Cb	3.04%Ca	0.01
Maize	6.03%Ab	10.31%Aa	0.01
Maize + Bagasse	4.26%Bb	7.88%Ba	0.01

A, B, C,

Mean values in the same column having different superscripts were significantly variable (P> 0.05).

a, b, c,

Mean values in the same row having different superscripts were significantly variable (p<0.05).

4.1.3- Crude fiber:

Table (3) shows the effect of additives and ensilage on crude fiber content of bagasse , maize and mixture .The mean values of crude fiber of bagasse , maize and mixture were 25.99%, 35.41% and 28.19% respectively . These results showed that crude fiber of bagasse , maize and mixture were significantly different ($p<0.05$) .in this study the crude fiber of maize silage was 23.41% lower than that reported by Brigstock (1994), who found the crude fiber of maize silage was 40% .Results of crude fiber of bagasse silage was 42.66%, it was higher than that reported by (AFFRCS1999),who found the crude fiber of bagasse silage was 31.9%. The treatment was effective on crude fiber of bagasse , maize and mixture in bagasse and mixture which was increased from 25.99% to 42.66 in bagass and from 28.19% to 37.37% in the mixture.

But in maize the crude fiber decreased 35.41% in untreated maize to 23.41 in treated maize.

Table 3: Mean values of crude fiber content of untreated ingredient and treated silages .

Ingredients	Before treatment	After treatment	SE
Bagasse	25.99%Cb	42.66%Aa	0.06
Maize	35.41%Aa	23.41%Cb	0.06
Maize + Bagasse	28.19%Bb	37.37%Ba	0.06

A, B, C,

Mean values in the same column having different superscripts were significantly variable (P> 0.05).

a, b, c, Mean values in the same row having different superscripts were significantly variable (p<0.05).

4.1.4- Ash :

Table (4) illustrates the difference in ash content between untreated and treated bagasse , maize and mixture .The mean values of ash of un treated bagasse , maize and mixture were 3.3%,8.08% and 5.96% respectively .

These results showed that ash content of treated bagasse , maize ,mixture were higher than the un treated ones , 5.58% , 8.54% , and 6.57%.

These showed that ash of bagass ,maize and mixture was significantly different ($p<0.05$). Results of treated maize ash 8.54% was higher than that reported by (Bristock 1994),who found the ash content of maize silage was 7.8%.In this study the ash content of bagasse silage was higher than that reported by (AFFRCs 1999.), who found the ash content of bagasse silage was 3.2% while in these study was 5.58%.The mean values of ash of bagasse , maize and mixture significantly increased at ($p<0.05$).It was observed that maize treated was significantly higher ($p<0.05$) than the other , while the ash content in untreated bagasse was lower than the other .

Table 4: Mean values of Ash content of untreated ingredient and treated silages.

Ingredients	Before treatment	After treatment	SE
Bagasse	3.3%Cb	5.58%Ca	0.029
Maize	8.08%Ab	8.54%Aa	0.029
Maize + Bagasse	5.96%Bb	6.57%Ba	0.029

A, B, C, Mean values in the same column having different superscripts were significantly variable ($P > 0.05$).

a, b, c, Mean values in the same row having different superscripts were significantly variable ($p < 0.05$).

4.1.5- Ether t:extrac

Table (5) shows the effects of additives and ensilage on ether extract content of bagasse , maize and mixture . Mean values of ether extract of treated bagasse,maize and mixture was 1.22%, 1.44% and 1.38% respectively . And the mean value ether extract of un treated bagasse , maize and mixture were 1.39%, 0.85%, and 0.85% respectively.

These results showed that the E E of untreated bagasse was significantly different ($p<0.05$) than the maize and mixture .Also the results showed that ether extract of treated bagasse decreased significantly ($p<0.05$) while E E of treated maize and mixture increased . These results were in agreement with finding that reported by (AFFRCs1999), who found the E.E content of bagass silage was 1.7%.

Table 5:Mean value of ether extract of untreated ingredient and treated silages.

Ingredients	Before treatment	After treatment	SE
Bagasse	1.39%Aa	1.22%Bb	0.03
Maize	0.89%b	1.44%a	0.03
Maize + Bagasse	0.9%b	1.38%a	0.03

A, B, C, Mean values in the same column having different superscripts were significantly variable (P> 0.05).

a, b, c, Mean values in the same row having different superscripts were significantly variable (p<0.05).

4.1.6- Metabolisable Energy (ME) :

Table (6) Illustrates the differences in metabolizable energy (ME) between treated and untreated bagasse, maize and mixture (bagasse+maize). The mean values of (ME) of untreated bagasse, maize and mixture were 11.4 MJ/kg, 9.7 MJ/kg and 10.7 MJ/kg respectively . These results indicated that there was significant difference ($p<0.05$) between treated and untreated ingredients. Also the Results showed that (ME) of untreated bagasse and mixture decreased significantly ($p<0.05$) from that of treated bagasse and mixture from 11.39MJ/kg to 9.52 MJ/kg and from 10.7 MJ/kg to 9.77 MJ/kg, respectively. where as the untreated maize increased in (ME) value from 9.73 MJ/kg to 10.73 MJ/kg than that of treated maize.

In this study the (ME) value of maize silage was in agreement with finding that reported by (Brigstock,1994).who found the (ME) of maize silage was 11.2 MJ/kg.

Table 6: Mean values of metabolisable energy (ME) of untreated ingredient and treated silages.

Ingredients	Before treatment	After treatment	SE
Bagasse	11.39MJ/kgAa	9.52MJ/kgCb	0.001
Maize	9.73MJ/kgCb	10.73MJ/kgAa	0.001
Maize + Bagasse	10.7MJ/kgBa	9.77MJ/kgBb	0.001

A, B, C,

Mean values in the same column having different superscripts were significantly variable (P> 0.05).

a, b, c,

Mean values in the same row having different superscripts were significantly variable (p<0.05).

4.2: pH

4.2.1: pH level of bagasse silage:

Table (7) shows the effect of different periods on pH levels of bagasse silage .The mean values of pH were 4.8,5.62, 5.03, 4.97, 4.43,4.40, 4.37, recorded for 14 , 21 , 28 ,35 , 42 , 49 , and 56 days after ensilage respectively. The results showed that bagasse silage pH level was significantly differed ($P<0.05$) between 14 days values (4.8) and 21 days value (5.62), there was no significant ($P>0.05$) difference between the first measured value after 14 days and last one after 56 days .The pH level of bagasse silage (4.37) in the last period (56 days) was found to be in conformity with 3.9 reported by AFFRCS (1999). Also the pH level at 14 days (4.8) was agreement with that (4.85) reported by Intesar (2003) .

The mean values pH in bagasse silage started low (4.8) and increased to (5.62) in 21 days and the decrease often reached (4.37) in last the period.

It was observed that bagasse pH level after 56 days was significantly lower ($p<0.05$) than the others except the levels in 14 , 42 and 49 days.

4.2.2: pH of maize silage:

Table (7) shows the effect of different periods on pH level of maize silage .The mean values of pH were 7.45, 4.83, 6.03, 4.6, 4.45,4.42, 4.39, for 14 , 21 , 28 , 35 , 42 , 49 ,and 56 days after ensilage respectively . The results showed that maize silage level was significantly different ($p<0.05$) between the first measured after 14 days (7.45) and all levels after it . pH level after 28 days increased from 4.83 to 6.03 ,which may be due to air entering in to the silage when the sample was taken . The pH level of maize silage (4.39) in the last period after 56 days was close to with (4.2) reported by (Brigstock, 1994) .

It was shown that maize silage pH level after 56 days from ensilage was significantly lower ($p<0.05$) than the other treatments.

4.2.3: pH of mixture (bagasse+maize) silage:

Table (7) shows the effect of different periods on pH level of mixture silage. The mean values of mixture silage pH were 5.56, 4.35, 4.36, 4.5, 4.42, 4.35 ,4.29, for 14 , 21 , 28 , 35 , 42 , 49,and 56 days after ensilage respectively . The results showed that the mixture silage pH level was significantly ($p<0.05$) different between 14 days level (5.56) and the other levels. There were no significant differences ($p>0.05$) between the level after 21, 28, 35, 42, 49, and 56 days. It was observed that the mixture silage pH level was significantly lower at ($p<0.05$) after 56 days than after 14 days , but there was no significantly different at ($p>0.05$) than the others .

Table (7) the effect of different periods on pH of (bagasse, maize, mixture) silages.

Treatment	Period in days							
	14	21	28	35	42	49	56	SE
Bagasse	4.80b	5.62a	5.03	4.97	4.43	4.40	4.37b	0.15
Maize	7.45a	4.83	6.03	4.60	4.45	4.42	4.39b	0.15
Mixture	5.56a	4.35	4.36	4.50	4.42	4.35	4.29b	0.15

a, b ,

Mean values in the same row having different superscripts were significantly variable ($p<0.05$).

CONCLUSION

The present study that addition of molasses and urea has a good quality silage from maize, baggasse and the mixture of maize, baggasse as seen from the lower pH (4.3) that was found . This is attributed to the possible formation of a high level of priopionic acid when molasses and urea were added to the ensiled fodder.

The study also showed an increase in the crude protein of the ensiled substrates.More investigation is needed in this area of research.

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