EVALUATION OF THE EFFICIENCY OF CONTINUOUS AND SINGLE BATCH CURING ON PALATABILITY, PRODUCTION AND NUTRIENTS AVAILABILITY ON WHEAT STRAWS

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DECLARATION AND RECOMMENDATION

Declaration

This research thesis is my original work and has not been presented for a degree or any award in any other university.

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DEDICATION

This research thesis is dedicated to my wife and children for their support throughout the period of study.

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ABSTRACT

In Kenya, many farmers are engaging in wheat production throughout the year, this makes the availability of straws huge. However, the presence of lignocellulosic complex makes their palatability and general intake limited. Intake also has been reduced by the rigid procedures available to the farmers. The nutritional value for wheat crop residue to ruminants is constrained by low nitrogen and high fibre contents. Introducing the continuous procedure of urea – ammonization and liming intends to take advantage of the excess ammonia on the already cured feed and the peak volumes of urease enzymes to quickly break urea to ammonia which is known to cure feeds in synergy with lime. Urea-Ammonization and liming of straws seem to be a feasible option for improving nutritive value, hence reducing the limiting effects of livestock production through feeds in the country. Treated wheat straws samples were ground in the laboratory hammer mill and the sample sieved through a 1mm screen and then analyzed in a laboratory to study the associative effect of ammonia and lime on the chemical composition of straws. The study analyzed for dry matter, total ash and crude protein of feed types. Data collection covered result from the three dairy cows in the three replicates. The dairy cows selected were those on zero-grazing setup and feeding will be uniform. The nine dairy cows, in three replicates were put on trials for a period of eighty four days. Specific data is on palatability and production of milk from benefits from treated straws on procedures of continuous and single batch methods of applying treatment. Secondly, with respect to the effect of effect of a single batch and continuous curing of wheat straw on dry matter intake by lactating dairy cows, the study concludes that there is no statistically significant difference in dry matter intake of wheat straw between single batch and continuous curing of wheat straw. However, urea treatment of wheat improves dry matter of wheat straw since there were significant differences in the amount of dry matter intake between treated and untreated wheat straw. Finally, in terms of the effect of a single batch and continuous curing of wheat straw on daily milk production of lactating dairy cows, it is concluded that urea treatment increases average daily milk production increased by approximately 20 %. However, the average differences are not statistically significant whenever the lactating cows are fed on continuously cured and single batch cured wheat straws. The study recommends that that dairy farmers should endeavour to utilize this technology to improve not only feed utilization efficiency of their dairy stock but also milk production which will ultimately lead to economic efficiency and higher profit margins. The non-significant differences between dry matter intake and average daily milk production of lactating cows when fed on either single batch of continuously cured wheat straw serves to advise dairy farmers that they should judiciously adopt continuously curing model which reduces the time taken to have the cured feeds available for consumption by dairy cattle.

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LIST OF ABBREVIATIONS

ADF	Acid detergent fiber
AOAC	Association of Official Analytical Chemists
CP	Crude protein
DMI	Dry matter intake
DM	Dry matter
GOK	Government of Kenya
GP	Gross Domestic Product
IVDMD	In vitro dry matter digestibility
TDN	Total digestible nutrient
RCBD	Randomized complete block design
NDF	Neutral detergent fiber
OM	Organic matter
NFE	Nitrogen free extract
NPN	Non protein nitrogen
OMI	Organic matter intake

CHAPTER ONE

INTRODUCTION

1.1 Background information of the Study

In tropical zones in the world, ruminants depend on year-round grazing on natural pastures or the animals are fed with cut grass and crop residues. Most of these areas face seasonal dry periods in which the availability of pasture decreases and also its quality by a reduction in the content of digestible energy and nitrogen. Due to the fact that in these areas, wheat straws are abundantly available from cultivating wheat, farmers offer wheat straw as the main roughage source to their animals. Feeding only wheat straw does not provide enough nutrients to the ruminants to maintain high production levels due to the low nutritive value of this highly lignified material (Gado, Elghandour, Cipriano, Odongo & Salem, 2017).

The high level of lignification and silicification, the slow and limited ruminal degradation of the carbohydrates and the low content of nitrogen are the main deficiencies of wheat straw, affecting its value as feed for ruminants. By treating wheat straw with urea and lime, the intake, degradability and milk yield can be enhanced, compared to feeding untreated wheat straw alone. In general, the use of rice straw as an animal feed as well as its treatment is always an economic decision (Zhang, Wu, Cai, Liu, Wu & Jiang, 2018). Agriculture plays a significant role in the world to feed the growing human population. Therefore, land for crop production will be used more intensively for human food production and consequently animal production will rely on feeding the by-products from the food produced for human consumption.

The agricultural sector employs most of the rural populace and contributes to over 24 % of Kenya's Gross Domestic Product (GDP). More than 80 % of Kenyan citizens also live in rural areas where agriculture is their main occupation (GOK, 2007). An intervention to improved livestock production goes a long way in reducing poverty and fundamental step in food security. Risk of livestock loss during dry seasons most of which emanate from lack of quality and enough feed to mitigate the dry spell has been felt in livestock farming communities and as a continuous or cyclic phenomenon. Achieving secure household incomes is generally assumed to be a fundamental step out of poverty and food insecurity especially from livestock as a farming option.

In practice, most smallholder ranchers feed crop residues with no type of handling, supplementation, or treatment, and subsequently affecting unfavorably on performance of animal production. Wheat straws and crop residue, in general, represent a large feed resource base for ruminants, especially during the dry season but remain underutilized for a number of reasons including being bulk to store and expensive transport. They have low nutritive value caused by high levels of lignification and high cell wall content (Mahesh & Mohini, 2013).

On a world scale, the total production of straws and other related materials has been calculated to be sufficient to meet the maintenance needs of all ruminant livestock.in many tropical and subtropical countries that cannot afford to use the land for forage production, straws is an is an essential basal food for ruminant livestock. A dairy cow in a single lactation produces five times as much dry matter in form of milk as is present in her own body.

The raw materials and the energy for the synthesis of constituents is the mammary gland, which is supplied by food. These high potential animals are exceptionally hard to keep up high levels of nourishing in early lactation when dry issue intake is low. Treating the wheat straw will go far in improving dry issue intake (Genc, Oldark & McDonald, 2010). Cost of production has additionally made animals producers diminish feed costs at whatever point conceivable. A harvest buildup due to accessibility are potential for diminishing feed costs for domesticated animals makers, but since of low edibility allow by domesticated animals is lessened astoundingly. Treatment of low-quality wheat with smelling salts and lime enhances edibility or aggregate edible supplements (TDN) and increment utilization of forages. The great impacts of ammonia and lime treatment on edibility and admission of low-quality scrounges are that it makes them a reasonable alternative in nourishing administrations of domesticated animals.

Urea- Ammonization and liming procedure in this study was mainly on wheat. In areas endowed with suitable conditions for agriculture and where most of the farmers are engaged with either dairy or wheat for farming or both. The Urea- ammonization and the liming procedure are intended to relatively be a simple procedure and easy to accomplish (Genc, Oldark & McDonald, 2010).

1.2 Statement of the Problem

Feed is an important limiting factor to the performance of livestock in Kenya, making an intervention on this factor is paramount. Plenty of wheat and other crop residue are left to rot in fields or fed unimproved leading to wastefulness. Efficiency in the procedure of

curing straws and feeding to animals went a long way in increasing intake per animal and by extension increasing overall livestock production.

Some studies have been documented in crop residue improvement but the procedure in undertaking the same is not efficient with farmers still losing their livestock during droughts. This study intends to fill this knowledge gap of straw treatment manipulation.

1.3 Justification for the Study

Fodder availability is increasingly becoming a problem with climate change. Mitigation to reduce wastage on the available straws and enhancing utilization through nutrients – boosting and efficient utilization is of great importance. It has been recognized that ruminants have a positive relationship between the digestibility of food and their intake. Although the rate of digestion and intake are related to the concentration of cell wall in ruminant foods, the physical form of the cell wall also affects intake. Treating the straws with lime and urea-ammonia changed the physical form of the cell wall and enhance intake. Urea-Ammonization and liming can be manipulated to convert the straw into useful ruminant feed efficiently. Furthermore, the overall overhead costs of rearing the animals is brought down by incorporating straw's and crop residue on the feeding regimes of the animals.

1.4 General Objective

The general objective of the study was to evaluate the efficiency of curing wheat continuously and on the single batch process.

1.5 Specific Objectives of the Study

i. To determine the effects of a single batch and continuous curing of wheat straw on nutrients available in the feeds of lactating dairy cows.

ii. To determine the effects of a single batch and continuous curing of wheat straw on dry matter intake by lactating dairy cows

iii. To determine the effects of a single batch and continuous curing of wheat straw on milk production in lactating dairy cows.

1.5 Hypotheses of the Study

i. There is a significant difference in nutrient availability between cured and uncured wheat straw for animal feed.

ii. There is a significant difference in daily dry matter intake (DMI) of single batch cured and continuously cured wheat straw by lactating dairy cows

iii. There is a significant difference in daily milk production of lactating dairy cows fed on single batch cured and continuously cured wheat straw.

1.6 Scope of the Study

The study was confined to only studying the efficiency of straws improvement with the use of Urea- ammonium and lime with samples taken from wheat as used in livestock feeding using continuous and single batch procedures. The study was undertaken during the period of harvesting of wheat (May to June every year), which is the only period suitable for availability of straws.

1.7 Limitation of the Study

The limitation of the study is that it only boosted nutrient using urea- ammonium and lime and not the full range of nutrients required by livestock.

CHAPTER TWO

LITERATURE REVIEW

2.1 Chemical and Physical Form and curing of Wheat Straws

The young plants have a thin divider that thickens as the plant develops. This outcome is a physical obstruction to the cell content concoction, enzymatic or microbial assimilation. Cell content is typically effectively processed and its supplements are promptly accessible. Nonetheless, the cell divider segments are accessible and processed to a specific degree, and this is a restricting variable as far as creature nourishment. Consequently, cell divider thickness, which changes with age, time and climate, is the principal factor influencing search absorbability. Cross area of the straw, perception demonstrates the presence of 3 layers; sclerenchyma parenchyma and essence (Mahesh & Mohini, 2013).

The sclerenchyma is a tissue made of lignified and thick-walled dead cells. The parenchyma is a tissue made of thin-walled living cells and the essence is an elastic cell tissue. Nonetheless, when the leaf of grain plant is seen in the transversal segment, three-segment can be seen; epidermis, sclerenchyma and mesophyll. Inside the sclerenchyma show up the phloem and the xylem which is a lignified segment. In the cell divider structure, one can see the cell lumen, at that point an auxiliary cell-divider, a centre lamella and essential cell-divider. Center lamella is made of cellulose fibrils inexactly bound to gelatin polymers, hemicellulose and basic proteins (Mahesh & Mohini, 2013).

2.2 Components of Cell- Wall and Cellulose

The fundamental mixes present in the cell-divider are; cellulose, pectines, a few proteins, lignin, silica, cutin, phenolic corrosive, tannins and the Maillard response items. Cellulose is the richest particle in nature. The atom is clearly basically in light of the fact that it is a direct polymer. Be that as it may, it is muddled by its three-dimensional structure, with H bonds both between and inside chains. It is available, in nature, in the crystalline shape sorted out as fibrils, with fundamental chains unequivocally connected together. This clarifies its mechanical quality and protection from compound corruption and concoction hydrolysis

2.2.1 Hemicelluloses

Hemicelluloses have been characterized as antacid dissolvable cell divider polysaccharides nearly connected with cellulose, made primarily out of D-Galactose-Galactose, D-mannose, D-xylose and L-Arabinose units consolidated in various blends. Hemicellulose is normally conformed to the cellulose fibrils (Fazaeli, Aziz & Amile, 2006).

2.2.2 Gelatin Substances

They are a gathering of related polysaccharides bottomless in delicate tissues. Gelatin is a straight chain of D-Galacturonic corrosive units with some methyl esters (Grabber, 2005).

2.2.3 Lignin

It's anything but a solitary compound yet a group of polymers of phenylpropane units composed in an intricate cross-connected three-dimensional structure. It begins from

three fundamental mixes subsidiaries from phenyl propane. Amid the lignification procedure, the relative measures of guaiacyl or pyridyl increment quickly. Phenolic acids, for example, ferulic acids and p-cumaric corrosive have been seen in the cell divider, connected especially to the hemicellulose particles by cross ester limits which could go about as lignin antecedent and would clarify the likelihood of hemicellulose-lignin buildings development. Much stays to be found about the topochemistry and ultra-auxiliary appropriation of lignin inside the tissues and cell dividers of plants. This absence of information has various commonsense ramifications, restricting our capacity to foresee the nutritive estimation of a feedstuff just from compound information; or the reaction liable to guarantee from medicines intended to upgrade the nutritive esteem (Wanapat, Polyorach, Boonnop, Mapato & Cherdthong, 2009).

Truly, the science of the extraction, solvolysis, hydrolysis, and investigation of cellulose and lignin from plant material. The investigations used to decide their relative substance are observational. With respect to the subject of organic structure of lignocellulose, as identified with its corruption in the rumen, scientists noticed that polymeric lignin ties basic starches, rendering the sugar inaccessible for microbial aging. Furthermore, low sub-atomic weight phenolic mixes. Likewise seem to tie glucans and xylans in an unpalatable complex. Particularly negative to scrounge absorbability is p-coumaric corrosive; this corrosive is additionally dangerous to ruminal microorganisms at bring down fixations than different acids. Ruminal growths seem to have a more prominent potential to corrupt lignocellulose than microorganisms do (Gado, Salem, Odongo & Borhami, 2011).

2.3 Rumen Microbial Requirement

It isn't conceivable to measure the nutritive estimation of a deposit or a side-effect for a ruminant when the necessities of its rumen organisms were not thought about. The meaning of miniaturized scale life form insignificant prerequisites for the diverse supplements isn't anything but difficult to decide. It has anyway been conceivable, through the rumen reenactment strategy utilizing fake rumen models like Rusitec, to get esteems which could be acknowledged as reference esteems. The aggregate Nitrogen (N) required is around 26 g for every kg of the absorbable natural issue. The commitment of reused N can diminish this incentive by 10 % to 40 % relying upon the level and kind of N present in the eating regimen. The sulfur (S) focus must be around 1.8 g of Sulfur for each kg of the stomach related natural issue (Babcock, Hayes & Lawrence, 2008).

In any case, the ideal level of S will rely upon its quality and accessibility in covering the smaller scale living beings prerequisites in the rumen. For customary feedstuffs, the S portion related to the protein, itself, which changes a considerable measure starting with one feedstuff then onto the next. For grain straw, the S degradability will, for the most part, be beneath 0.3 %. Around 5 g of dissolvable Phosphorous per kg of the absorbable natural issue is by all accounts adequate to cover the prerequisites of the rumen organisms. Concerning branch chain unsaturated fats and the vitamin B complex, it is realized that they enhance the fibre absorption and crossed sustaining among miniaturized scale living beings. As a rule, one can state that the pH will not diminish beneath 6.0 and that all supplements ought to be given on a persistent way, particularly when the

sustaining source is gradually debased, which frequently happens with the scrounges (Grabber, 2005).

2.4 Standardization of in Vivo Digestibility Measurements

With respect to the institutionalization of in vivo edibility estimations and from what has been said previously, it is conceivable to assess straw, particularly untreated straw, sustained alone as a result of the unbalance caused in the rumen microflora. Plus, in the event that it will be estimated with a blended eating regimen, alternate segments must be roughages and the level of boring feedstuffs must be negligible to keep an association with the kind of miniaturized scale living beings that will be advanced in the rumen-reticula.

Then again, one must characterize that in the event that it is an incentive to be arranged, at that point the level of admission must be balanced near the upkeep level in light of the fact that there is a coordinated impact of the admission level on absorbability. This will cause the edibility of straw stays autonomous of its extents in eating regimen, and one can dodge the impact got from the connection. Another preferred standpoint is the no presence of refusals.

Other vital parameters to contemplate are the accumulation of the period. Sixteen days have been considered as the base timeframe required, where the most recent six days would be the accumulation time frame; in any case, it is suggested a gathering time of somewhere around 10 days for straw. The adjustment time frame differs from one to half a month, contingent upon the kind of feedstuff the creatures are eating before the trial consume fewer calories. The quantity of creatures relies upon the fluctuation expected,

yet four is, the base number acknowledged. The use of treated straw in down to earth conditions needs more a nourishing an incentive than a nutritive esteem, which implies a proportion of the intentional feed admission of the straw (Borba & Ramalho Ribeiro, 1994).

In vivo digestibility of wheat straws

DM	DM	OM	CP	ADF	NDF	ADL	ENERGY
UNTREATED STRAW	39.5	42.1	-77.4	44.3	47.3	8.5	41.6
TREATED	46.8	48.5	40.1	55.1	60.7	17.4	50.5

Source; In vivo digestibility (%), mean values (n=8) standard error (Borba & Ramalho Ribeiro, 1994).

When compared with different forages, wheat straw is of poor nutritive value and low absorbability to the ruminants because of its higher corrosive cleanser fibre (ADF) content. Lignin is a fundamental constituent of ADF and is non-edible by ruminants and impervious to a large portion of the microbial enzymatic frameworks also. The nearness of lignin and its hemicellulose restricting framework expands the inaccessibility of other vitality containing constituents Concoction present in the farming deposits for the ruminants. Upgrade of the nutritive nature of wheat straw by limiting the lignin substance may help take care of this issue. To make straw based weight control plans fruitful, the system for treatment and the constraint of the straw must be recognized and remedied. Straw is low in vitality, low in protein and extremely lacking in a few minerals.

Natural evacuation of lignin can possibly change over the straw into more nutritive and effortlessly absorbable feed of good quality. The structure of plant biomass oversees their helplessness to microbial corruption. Holocellulose comprises countless strands, while lignin is an inedible biopolymer, which additionally ties to Holocellulose and makes it blocked off for the ruminants. The proportion of these plant cell divider constituents may fluctuate contingent on the different ecological variables (Gado *et al.*, 2011).

Lignin is the most inexhaustible heterogenous normal biopolymer after cellulose, and it is involved three primary phenolic propanoid units. The proportion of these monomer alcohols shift in lignin of various source and influence the degradability of plant cell divider. It has been recommended that profoundly fanned lignin is inhibitory to cell divider degradability. In this way, lignin organization may administer the weakness of aggro buildup to microbial assault (Lara-Flores, 2017).

Plant cell divider contains three sorts of auxiliary polysaccharides, in particular cellulose, hemicelluloses and pectic polysaccharides. In straws, the polysaccharide creation is fairly basic, with cellulose and xylans as the prevalent parts alongside the little measure of polysaccharides containing mannose, galactose and most likely pectic segments. Cellulose in plants is made out of both crystalline and indistinct structure. To enhance the nutritive estimation of sinewy harvest buildups, urea treatment of straws was produced as an option in contrast to harsh/destructive sodium hydroxide treatment, for utilize for the most part in tropical nations. An expansive number of on-station and on-cultivate preliminaries led in a few nations under various conditions have demonstrated that nourishing urea-treated straws opposite untreated straws builds feed allow by 10 % to

15%, the development rate of calves by 100 g to 150 g/day and drain yield by 0.5 l to 1.5 l/day.

Urea-treated straw is more acceptable and absorbable. The dry issue (DM) edibility increments by roughly 10 rate units, the aggregate absorbable supplements (TDN) esteem increments by 10 to 15 rate units and the CP content increments just about three times. The criticism got from the agriculturists in on-cultivate trails has been to a great extent positive. The way to enhancing the utility of straws, stalks and stovers for ruminants is to beat the boundaries which confine their microbial maturation in the rumen (Wanapat *et al*., 2009).

The two central point restricting microbial processing in the rumen are high lignin and low-nitrogen substance. A 10 % expansion in cell-divider assimilation would result in a sparing of 2 million tons of grain supplement and reduction fertilizer solids by 2.8 million tons and increment creature profitability (Smith and Williams, 2016). Various physical, synthetic and organic medications have been looked into and created worldwide so as to enhance the use of straws as feed for ruminants. Nonetheless, these advancements couldn't be managed as a result of the mind-boggling expense of synthetic substances, despondency toxicity of straws or issues in scaling-up or applying the innovations under field conditions. A mix of innovations reasonable for field condition ought to be created. The level of crystallinity is accepted to influence the rate of its decay by cellulolytic life forms; the more noteworthy the level of crystallinity, the slower is the rate of microbial cellulose debasement. In spite of the fact that the cellulose of wheat straw can be used by ruminant creatures, edibility regularly is constrained by its low protein content and a high

level of lignification. Hemicellulose is antacid solvent cell divider polysaccharides that are nearly connected with cellulose (Mahesh & Mohini, 2013). Other natural particles like cutin and suberin have been accounted for to be nearly connected with starches in the cell of plants. Physical incrustation of plants filaments by methods for ligno-starches buildings renders them distant to synthetic debasement and for proteins that would regularly process them.

Solid concoction securities which exist among lignin and numerous plants polysaccharides and cell divider proteins render these mixes inaccessible amid assimilation as the edibility is by and large conversely connected to the measure of lignin in the substrate. The dissolvable period of silica is additionally connected with the brought down edibility of straw.

Further, it has been expressed by the researcher that lignin is the absolute most mindful factor for diminishing absorbability esteems for the straws of wheat at 40% to 55%. In this manner, evacuation of lignin has turned into an essential for the proficient usage of sugars from lignocelluloses other than enhancing their attractiveness. Methane generation emerges primarily from microbial maturation of hydrolyzed dietary sugars, for example, cellulose, hemicellulose, gelatin and starch. The measure of methane delivered amid ruminal maturation is needy upon the idea of the substrate being aged. Eating regimen sythesis adjusts the absorption proficiency of creatures subsequently methane generation. By and large, the methanogenic capability of ruminal microflora is most prominent for the maturation of basic sugars contrasted with that of non-auxiliary starches (Firkins & Yu, 2015). This is the motivation behind why ruminants radiate more methane on sinewy

eating regimens. Organic medications can be utilized for enhancing the encouraging estimation of low-quality stringy harvest buildups. The unavoidable natural issue misfortunes amid organic medicines suggest that an expanded OM absorbability is expected to make up for misfortunes. Thus, SSF for a time of 6-8 days has been suggested as the greatest time of ageing to decrease DM misfortune. In spite of the fact that change in the nutritious worth of organically treated yield buildups is accomplished, many are not sparing and the procedure has not yet streamlined under field conditions. Thus, the conceivable eventual fate of the innovation should center around the accompanying regions (Hadjipanayiotou & Economides, 1997).

Detachment and ID of the specific and profoundly ligninolytic parasite in nature and developing it for the business creation of ligninase chemical (FAO, 2011). Advance biotechnological methods for hereditary amplification of ligninolytic parasite to such an extent that just lignin is corrupted with no more noteworthy change in cell divider starches should be created. Once demonstrated growth is distinguished, its capability to update (improving edibility) different agro results (husks, straw, stovers, bagasse and different stringy lignocellulosics) that are generally utilized as utilized as domesticated animals feeds ought to be considered. What's more, the center ought to be given to building up a straightforward and financial innovation for viable usage particularly at little and blended cultivating frameworks in creating nations which may somewhat take care of the regularly expanding issues of feed emergency to domesticated animals (Zijistra & Beltranena, 2013).

2.5 Urea as a Chemical

Urea is a white crystalline strong natural compound, broadly utilized as a nitrogen compost. Unadulterated urea has a nitrogen centralization of 46.6 %, comparable to an unrefined protein substance of 290 g for every 100 g of urea since protein itself has just 16 % nitrogen. Urea is effectively separated to smelling salts by the urease compound that is delivered by soil or rumen small scale life forms. As a non-protein nitrogen-source urea can supplant some portion of the dietary protein in the ruminant eating routine. Rumen miniaturized scale living being first separates urea to smelling salts, which at that point fills in as a nitrogen hotspot for the generation of microbial protein, eventually filling in as a protein hotspot for the host ruminant. Urea, when utilized for the treatment of straws upgrades the wholesome nature of straw as far as expanded nitrogen content, enhanced satisfactoriness and edibility of straw. Amid the treatment procedure, smelling salts is produced from urea, and within the sight of water, it frames the soluble base named ammonium hydroxide. It has been settled that salt treatment improves the cell dividers accessible for maturation in the rumen. In mild atmospheres, anhydrous (vaporous) smelling salts or fluid (alkali disintegrated in water) is utilized for the ammoniation of straws. In hotter atmospheres, the urea treatment is more possible in light of the simple accessibility of urea and its snappy separate into smelling salts mixes under higher surrounding temperatures (Mapato, Wanapat & Cherdthong 2010).

2.5.1 Techniques for splashing

For showering of the urea arrangement over a layer of 100 kg straw or whatever quality that is picked, a planter's sprinkler can be to accomplish consistency in urea arrangement interacting with straw. Utilization of a sweeper and a basin has additionally been observed to be powerful to spread the water. For cleaved wheat straw, some hand blending after the shower of urea arrangement is alluring (Singh & Chander, 2011).

2.5.2 Conservativeness of the stack

Once a layer of 100 kg has been dealt with, an extra layer of 100 kg is set to finish everything and showered with urea. This procedure is rehashed to make a stack. A smaller stack has two preferences; right off the bat the viability of the ammoniation procedure is better. Besides, there are less odds of shape development which prompts decay of the straw. Cleaved wheat straw compacts exceptionally well amid stack making. Such smallness can't be accomplished so effortlessly in free straw, however packages are superior to lose unchopped straw (Zijistra & Beltranena, 2013).

2.5.3 Span of treatment

Since the temperature of the stack influences the rate of hydrolysis of urea to alkali, the term of treatment can be variable, contingent upon the district or season where the treatment is finished. The impact of outside temperature on treatment time with urea is somewhat misty, however urea treatment isn't well conceivable in colder districts with snow and ice. For the most part, be that as it may, the temperature inside the stack is higher than the outside temperature, because of microbial activity and additionally substance responses between urea, water, smelling salts and straw. What's more, since it

is at last the stack temperature that decides the response procedure, it seems basic that the underlying temperature is sufficiently high to kick the procedure off. Practically speaking, it creates the impression that when the straw is dealt with under conditions with a surrounding temperature of around 20 degrees (amid daytime), within temperature in a urea regarded straw stack can be as high as 50 degrees to 60 degrees in 1-2 days. All things considered, the outside temperature is unessential to what occurs in the stack. Ammoniation times of seven days or less are appeared to be adequate under tropical conditions (Beam, Brilliant & Beam, 1996).

The term of the treatment can likewise be settled on, by thinking about the neighborhood conditions and the size of the treatment. Littler amounts can be dealt with on week by week premise, requiring less work on the double, winding up business as usual creature nourishing practices. In certain cultivating frameworks straw is put away in vast stacks for a long time. In such circumstances, a few agriculturists wish to treat straw with urea at the season of stacking directly after reap however it includes more work around then. In this manner, likewise the span of the treatment turns out to be longer. A time of no less than a little while has been proposed to be vital for the treatment of straw in the winter months when the encompassing temperature is lower. As an alert the more drawn out the times of capacity the higher the danger of waste by molds particularly when the straw is excessively wet (FAO, 2011).

2.6 Types of Crop Residue Used

The sort of harvest buildup utilized and its underlying nourishment quality influences the viability of treatment. The poorer the underlying nature of the straw or Stover, the higher

the impacts of treatment, perhaps on the grounds that better quality straws have more cell solubles and bring down fiber content, the last really getting the advantage of ammoniation.

2.6.1 Storage Technique

A key factor which decides financial aspects and practicability of the urea treatment of straw is the utilization of capacity structures for the treatment. Agriculturists for the most part favor stockpiling techniques in view of existing custom, yet new ways are discovered adequate relying upon their expense. Covering of the stack is critical, however especially the bigger, and all the more thickly pressed stacks could be open, i.e. secured with just a layer of untreated straw. Fixing should be possible with materials like polyethene, banana leaves, or void urea packs sewed together. Agriculturists additionally utilize different capacity structures like earthen pits, fixed and secured with banana leaves, wooden or established clasps, solidified storehouses rings or pipes. Aside from that, urea showered straws can likewise be stuffed in sacks produced using polyethene or by sewing void straw packs.

The pit framework, i.e. an opening in the ground, conveys the danger of defilement with soil or leakage of water through the sides. Stacking and emptying of the pit are likewise troublesome, and the burrowing of pits can be an issue in rough soil. The distinctive strategies for stacking or putting away urea showered straw have their relative merits and merits, yet the primary concern about every one of these techniques is that the better the compaction and airtightness of the stack, the better will be the nature of the treated straw.

At last, the agriculturist needs to choose as indicated by claim inclination (Ray, Golden & Ray, 1996).

2.7 The Relation between Outside Temperatures with Required Treatment Time

Usually, the temperature inside the stack is higher than the outside temperature, due to microbial action and /or chemical reactions between urea, water, ammonia and straw. And since it is ultimately the stack temperature that determines the reaction process, it appears critical that the initial temperature is high enough to get the process started. Bigger stacks or heaps can control the temperature better than smaller heaps. Ammoniation period of seven days or less is shown to be sufficient under tropical conditions. The duration of the treatment can also be decided upon by considering the local condition as well as the scale treatment. Smaller quantities can be treated on weekly basis requiring less labour at once, becoming part of the routine animal feeding practices (Mahesh & Mohini., 2013).

2.8 Ureolysis and Ureolytic Medium

The urea treatment is the consequence of two procedures which happen at the same time inside the mass of scavenge to be dealt with; ureolysis which transform urea into alkali, and the along these lines created impact of the smelling salts on the cell dividers of the scrounge. Ureolysis is an enzymatic response that requires the nearness of the urease catalyst in the treatment medium. As per research and much field encounter procured amid the most recent decade, adequate urease is created by the earthly ureolytic microorganisms amid the treatment of buildups, for example, straw or maize stalk, at any rate under conditions where dampness forces no restrictions (Gado *et al.,* 2009).

2.8.1 Moisture Content

Aftereffects of both trial and useful work completed as of recently demonstrate that this rate ought to never be under 30 %, and not more prominent than 60 %. Beneath 30 %, ureolysis can be extremely lessened or even not happen. Just in the particular instance of purposeful water decrease 20 l to 25 l added to 100 kg straw (Mohesh & Mohini, 2013). For motorization purposes, will the expansion of urease be fundamental, despite the fact that this is for the most part done through the expansion of ground crude soya beans in the urea arrangement. Beneath 30 % it would likewise be more hard to pack the mass of search and remove the air when the rummage is in free frame (less issues are experienced with bundles since the plant is as of now squeezed (Mapato *et al.,* 2010). Thus, an absence of smelling salts and an abundance of oxygen in a medium with adequate dampness will prompt an awful soluble base treatment and to form advancement. Past as far as possible (50 % to 60%) the issues experienced will be:

a) The insufficient consistency of the search mass,

b) Leaching of the urea arrangement towards the base layers (urea/smelling salts overdosage with its related harmfulness dangers),

c) Insufficient dispersion of the produced smelling salts inside the scrounge mass, in perspective of its hygroscopic trademark (alkali would tie to the water rather than the plant cell dividers), and

d) Development of molds, as a result of the dampness and a deficient alkali condition (caught by over the top water). Inside this prescribed range, there are no settled tenets and the measure of water to be added will be left to the rancher's judgment as indicated by the

overall neighborhood conditions, e.g., accessibility and cost of water, the sort of scavenge to be dealt with (its structure and similarity). A measure of 50 kg of water to add is a simple figure to recall and is for the most part connected at the functional level. At the point when added to 100 kg of a 90 % DM straw, it prompts a last dampness of 40 % (Wanapat *et al*., 1996).

2.8.2 Temperature and Span

The ideal temperature of ureolysis should lie between 30 degrees and 60 degrees, as indicated by the sort of urease. At the point when the temperature increment or lessening by 10 degrees the speed of the response multiplied or split, individually. Inside the scope of temperature of 20 degrees to 45 degrees the ureolysis can be finished following multi week, or even 24 hours. The temperature is in this manner not a worry in tropical atmospheres. Nonetheless, the action of urease is either extremely diminished or even smothered for temperatures underneath 5 degrees to 10 degrees. One must, along these lines, be extremely cautious in tropical good countries where night ice can amid the dry season when the time has come to treat the straw (Sawar & Muhammad, 2006).

2.9 Alkali Effect of the Generated Ammonia

The elements guaranteeing a decent soluble base impact are obviously the same as on account of alkali treatment and they have been completely assessed by Sundstøl and Owen (1984). The criteria of stickiness, temperature and their cooperation, essential for successful ureolysis, will marginally support the soluble base treatment. Be that as it may, length, kind of rummage or more all alkali (and in this way urea) dose and their cooperation should be taken into close thought.

2.9.1 Urea Measurement/Kind of Scrounge/Length

The amount of salt to be utilized is the principal factor in charge of the effectiveness of soluble base treatment. A few marvels are clearly included and are hard to separate;

an) At a given smelling salts measurements, the urea treatment is most presumably more effective and the propensity is to diminish the amount of urea;

b) Regardless of whether it is more proficient than smelling salts treatment, the urea treatment is slower. It is, in this way, conceivable that a few creators, chipping away at medicines of a brief length, as regularly occurs in tropical territories, did not watch the normal response to an expansion in urea dose (Trach, 1998).

c) Most importantly, the limit of the rummage to respond to basic treatment relies on the herbal family, the species and the assortment to which it has a place. Little is known and in this way it is hard to evaluate, in the nature and the structure of the cell dividers (lignins) what could what could disclose this ability to respond to basic treatment. Thus, there would, in this manner, be not one of the few doses of salt, varying as indicated by the herbal family, species and assortment to which the straw or scrounge has a place (Da Silva, 2015).

For example, measurements which are adequate for specific straws, probably won't be for other people, and presumably less so for wheat straws. The limit of a straw to react to basic treatment demonstrates a relationship to its buffering limit (phosphate) and to the saponifiable ester linkages or optical thickness at 280 nm of the support separate. It is seen that this limit is all the bigger as the underlying edibility of the straw is low, and that the connections between starting absorbability and reaction to treatment are particular to

the organic species. In such conditions, the choice ought to be taken in a down to earth circumstance. The lion's share of both exploratory and field work has reasoned that the prescribed dosage is 5 kg urea for every 100 kg of straw. This dosage gave great outcomes in many field venture (Mesfin & Ktaw, 2010).

2.9.2 Term/Surrounding Temperature

The term of the salt treatment is longer than the ureolysis procedure. The suggested treatment time ranges from over about two months for temperatures around 5 degrees to less multi week for temperatures over 30 degrees. In traditional tropical atmospheres, the salt treatment would thus be able to be accomplished following multi week. In any case, in perspective of what has been said before, the span to be suggested by and by ought to never be underneath multi week. As treatment proficiency enhances with time it is fitting to hold up about fourteen days before opening the stack except if limitations make this inconceivable (Garg & Bhanderi, 2011).

2.9.3 Air and Water Snugness

Smelling salts is discharged considerably more gradually from the ureolysis procedure than from an anhydrous alkali tank infusion. The dangers of misfortunes of alkali into the climate is diminished since smelling salts can tie on the scrounge cell dividers and on the water medium at the same time to its discharge. Be that as it may, just around 1/3 of the alkali discharged can tie the plant material the rest of the 2/3 being in a labile frame is lost. This point will be simply more imperative as the capacity term is long and the volume of material treated is little. In reality the point is to keep up a climate as anaerobic and ammoniacal as conceivable inside the mass of search so as to accomplish the best

treatment as well as the littlest improvement of molds conceivable. Different kinds of medications have been depicted in many audit papers including chest and kayouli and in specialized flyers. There is certifiably not a solitary settled model strategy however contemplated methods which should each adjust to the predominant agro-monetary which are, the straw or rummage molding: free shape, either long or slashed, bunches, either physically or mechanically squeezed, the amount of scavenge or straw to be dealt with required, contingent upon the quantity of creatures and the time amid which they must be sustained (Blümmel, Samad, Singh & Amede, 2009).

The ranchers' specialized ability and offices and his financial plan. Once treated and if adequately very much canvassed to be kept up in anaerobic conditions, the search can be put away for a while. It is along these lines in a solitary task conceivable hypothetically to treat the amounts required for the entire nourishing period. These amounts may, be that as it may, be some of the time too huge and require excessively work and storage room. It is then important to treat littler amounts in progressive activities continued amid the time of sustaining. Different sorts of medications are conceivable relying upon the methodology picked which will meet the ideal trade off among recurrence and size (Da Silva, 2015).

They extend from the little pit delved in the dirt (just in firm mud and not depleting soils) to the traditional squeezed parcels stack secured with plastic sheets, as in the anhydrous smelling salts treatment with all the middle person arrangements, for example, bushels or some other versatile holders, different sorts of clips (3 dividers framework), existing developments e.g. storage facilities, unused pens. The fundamental purpose of debate,

after urea measurement and dampness rate managed before, is the air and water snugness of the treatment medium. Frequently now it is said that the urea treatment does not require any covering: such exhortation is hazardous and questionable. At the point when the treated roughages must be put away for quite a while, it is important to cover it keeping in mind the end goal to maintain a strategic distance from shape improvement and poor smelling salts obsession (Plata & Bárcena-Gama, 1994).

Anyway down to earth field perception in tropical Asia, which were affirmed tentatively in Spain demonstrated that on account of expansive stacks, it is conceivable to cover them with untreated piles or parcels of straws that give a self-cover. The external straws, which is obviously to some degree harmed, speak to just a little extent in examination with the entire main part of palatably treated. This perhaps does not have any significant bearing on account of little amounts to be dealt with where covering stays vital. In these last cases anyway the utilization of nearby material can tackle the issue without depending on the regular plastic sheets. It has as of late been demonstrated that mud is an effective option in contrast to plastic for covering expansive urea-treated stacks (Highstreet & Robinson, 2010).

2.10 Assessment of Treatment Efficiency

The best evaluation of the treatment impact is, obviously, the creature's reaction as far as admission and exhibitions. In any case, in field conditions, the inquiry regularly emerges by the expansion operators on opening the storehouse, pit, clip or they plan with the ranchers how might they make sure, that their treatment has been fruitful before nourishing it to the creatures. Without broadly expounding discussion connected with the

expectation parts of the bolstering estimation of treated (and in addition untreated) straws and low quality roughages, we can outline by saying that the first and least complex foundation of a fruitful treatment is the physical part of the treated roughage:

a) A stamped change of shading from darker (dull yellow isn't sufficient),

b) Solid however great alkali smell with no hint of awful aging,

c) Smooth surface of the straw or the stalks which turn out to be anything but difficult to wind and to twist,

d) Nonappearance of any shape. In the event that uncertainty continues, the Kjeldahl N test can be utilized.

On account of anhydrous smelling salts, a poor soluble base treatment is for the most part connected with a poor nitrogen obsession and thusly low unrefined protein content. The addition of the unrefined protein substance of DM ought to in any event be of 5 %-6 % (CP/DM from 3 %-4 % up to 9 %-10 %), considering the efficient 2/3 misfortune as labile smelling salts that can't tie. On account of urea treatment one essential point, which is by and large misconstrued, is that, when the examine is done on the dry example as over, a more noteworthy addition isn't really synonymous with an effective treatment (Fazaeli Aziz & Amile, 2006).

Despite what might be expected, it ought to caution that leftover urea has not been completely changed over into smelling salts due to incomplete ureolysis (and, in this manner, just a little alkali has been delivered). In actuality, a 4 % CP straw treated with 5 kg urea/100 kg closes with a CP substance of 18.6 % when no ureolysis has occurred. At the point when the test is done on a crisp and non-circulated air through example the CP

substance might be high as well, reflecting non hydrolyzed urea as well as labile smelling salts assimilated yet not bound to the plant;- the third step, which is just legitimized when managing generally high delivering creatures that must not be starved, is to utilize the expectation of absorbability/allow in perspective of the requirement for more accuracy;

a) The traditional proximate feed examination can not the slightest bit foresee any bolstering esteem. As CF (unrefined fiber), NDF (impartial cleanser fiber), ADF (corrosive cleanser fiber), and ADL (corrosive cleanser lignin) are of no utilization, they are not suggested (Qingxiang, 2002).

b) The main choices accessible are the in Sacco procedure or gas test for degradability estimation or cellulose or in vitro absorbability forecast which is anyway costly.

2.10.1 Reaction to treatment

At the point when legitimately accomplished and used, urea medications can expand the CP content by a normal of 6 % to 7 %. In any case, a state of intrigue, said by a few creators, however frequently overlooked is the generally terrible use by the creature of the nitrogen given by treatment, which is reflected by the high nitrogen fecal discharge. Subsequently, agriculturists in reality watch a superior agronomical estimation of the fertilizer gathered from the creatures bolstered with treated roughages (Huhtanen, Rinne & Nousiainen, 2007).

The natural issue edibility increments by a normal of 10 % to15 %. The change of absorbability is simply more critical as the underlying edibility is low. The last point features the requirement for additionally investigation into expectation criteria of low quality harvest buildups absorbability that would empower to recognize the better ones

before the choice to treat;- The roughage allow by around 40 % subject to much variety, depending basically upon the manner in which the treated roughage is sustained (extent and nature of the supplement in the eating regimen) and the sort of creatures. With respect to the creature's exhibitions, treatment enhances the healthful status of creatures and their exhibitions;- at the same suitable level of supplementation, treated roughages contrasted with untreated roughages guarantee normal change of 200 g/day of the normal day by day gain for developing steers and expanding by 1.0 kg to 2.5 kg drain gathered every day over the sum suckled by the calf (Bhatta & Jakhmola, 2005).

There are extensive variety in straws as indicated by their species, assortment, developing conditions and climate at reap. For useful use by agriculturists, urea is more secure than utilizing anhydrous or fluid smelling salts and furthermore gives a wellspring of nitrogen (unrefined protein) in which straws is inadequate. Since urea is a strong compound, it is likewise simple to deal with and transport and urea can be acquired in many creating nations. Furthermore, urea is significantly less expensive than NaOH or NH3. Straw assortments with a low degradability reacted preferable to urea medications over amazing straws, expanding the in vitro dry issue degradability from 45 % to 55-62 %.

Urea treatment may, in this way, be the most suitable relieving alternative for little scale ranchers to enhance the nature of straws, especially indicating low degradability. Albeit straw is a critical feedstuff, and in reality the staple feed vast parts of the creating nations for ruminants, it isn't favored by creatures. Previously, different examinations including urea treatment of straws, with or without extra supplementation, were performed not just in the research facility and furthermore in field preliminaries; it demonstrated that

expansion of Ca (Gracious) 2 to urea enhanced the IVDMD (Highstreet & Robinson, 2010).

Field exhibits that a blend of 5 %, Urea in addition to 6 % Lime at 50 % dampness for three weeks brooding time was the best treatment for enhancing degradability of straws. To enhance use of yield deposits agriculturists were cleaving, supplementing with concentrates and scavenges, destroying, and applying some synthetic treatment. Destroying decreases wastage of product buildups by creatures. Be that as it may, agriculturists need to know the reasonable size and how to reliably achieve the proper molecule measure. In spite of the fact that straws are an imperative feedstuff, and without a doubt the staple feed in substantial parts of the creating scene for ruminants, it isn't favored by creatures. A normal for straw is that it mostly comprises of exceptionally lignified cell divider material, which regularly establishes up to 80% of the dry issue. This comprises of real extents of cellulose, hemicellulose and lignin which happen in the proportion 4:3:3, individually while the rest contains nitrogenous mixes and powder. Grain straws ordinarily contain no less than 70% starches and are, in this way, a potential wellspring of vitality for domesticated animals, which can be used through microbial aging in the rumen. Nutritive estimation of straws is controlled by the compound characteristics of straw that farthest point the assimilation of cellulose and hemicellulose (Pedersen & Meyer, 2010).

These characteristics incorporate lignification, silication, the crystallinity of cellulose, and so on which are known to be the inalienable nutritive limitations in straw. Despite the fact that these deposits contain enough cellulose to make them a phenomenal

wellspring of vitality for ruminants, these are low quality feeds in their characteristic state on account of their low protein content (2.5% to 6%) related with high lignin (7 % to 14%). The significant piece of the protein is in all likelihood connected with the cell-dividers which are known to have low absorbability. In this manner gives off an impression of being a curvilinear impact of supplementation on the admission of straw (Bhatta & Jakhmola, 2005).

By and large, straws like wheat straw contains (on dry issue premise) 85% to 94 % natural issue (OM), 2.5 % to 5% unrefined protein (CP), 40% to 44% rough fiber (CF), 45% to 46 % nitrogen free extractives (NFE), 0.16% to 0.22 % Calcium and 0.05% to 0.14 % phosphorus. The concoction piece and vitality substance of rural results are displayed in tables1.2 and 3, individually. The decision of supplementing straws with searches and thinks has been accounted for to positively affect creature efficiency while concoction treatment and ensiling have demonstrated a beneficial outcome on edibility and drain yield in dairy cows. It has been distinguished that nourishing practice that enhancing nutritive estimation of the feed asset represented a test to agriculturists in using the feed asset viably. Along these lines a sustaining preliminary was intended to distinguish reasonable mediations to enhance the nutritive estimation of product buildups for better usage, results have been accounted for by Kashongwe and Osoo (2014).

Principle basal feeds for ruminants in the warm atmosphere of creating nations are basically trim deposits and low quality grasses from rangelands and the fundamental goal are streamline the stomach related utilization of this low quality roughages and to rapidly treat them. Ureolysis is an enzymatic response that requires the nearness of the urease

compound in the treatment medium. Urease is for all intents and purposes missing in straw which is a dead graminaceous material. As per look into work and the various field encounter gained amid the most recent decade, urease delivered the earthly ureolytic microscopic organisms amid the treatment of deposits, for example, straw or maize stalks, is adequate, at any rate under conditions where stickiness forces no restrictions. Just in the particular instance of deliberate decrease of water (20 l to 25 I added to 100 kg straw) for motorization reason will the option of urease be essential. The physicochemical states of treatment, specifically moistness and temperature, and their collaborations, must, in this way, support the movement of these microbes and that of their protein (Kashongwe & Osoo, 2014).

2.10.2 Mugginess

The perfect mugginess of ureolysis is 100 % (water arrangement), obviously, difficult to reach in a complex (heterogeneous) medium made out of plant material and water. This is the reason; by and by, the water substance of the medium is one key factor in the accomplishment of the (urea treatment). This additionally why there are such huge numbers of opposing statement.

2.10.4 Alkali treatment of the generated ammonia

Factor guaranteeing a decent soluble base treatment is, obviously, the same likewise with smelling salts treatment. With respect to and temperature, and their connection, the parameters expected to be as of now met for a decent ureolysis are likewise supporting

the soluble base treatment. Ammoniation of product deposits through urea treatment is considered as the most suitable compound technique to enhance sustaining estimation of yield buildups for ruminants.

Ensiling urea treated harvest buildups with fermented fermentable sugars settle nitrogen (N) better, acquire physicochemical changes ammoniated product deposits that support better ruminal capacities admission and edibility than untreated yield deposits (Sawar, et al., 2006). The compound creation of 4 % urea treated wheat straw ensiled without fermented molasses is higher than urea treated wheat straws with fermented molasses. The urea treated wheat straw ensiled with 6 % fermented molasses had roughly twofold N focus in urea treated wheat straw, it likewise enhanced the impartial cleanser insoluble nitrogen (NDIN) content in urea treated wheat straw. The nonpartisan cleanser fiber substance of urea treated wheat straw ensiled with fermented molasses was higher than urea treated wheat straw ensiled without fermented molasses. Nonpartisan cleanser fiber content on CP free premise was comparable for urea treated wheat straw ensiled with or without fermented molasses.

The nature of salt to be utilized is the primary factor in charge of the effectiveness of soluble base treatment. The larger part of anhydrous smelling salts treatment includes amounts of alkali of 3 kg for every 100 kg DM of treated straws. This figure would relate, if ureolysis add up to, to 5.3 kg of urea for every 100 kg DM of straws (Wanapat et al., 2013).

Numerous initiators don't watch the expansion in edibility of the treated issue that could have been normal with an expanded measurements of connected urea. Some even go far

as to prescribe the utilization, rehearse, of limit measurements of urea of 5 kg for 100 kg straws, for absence of proof that higher dose would enhance treatment. This limit can basically be connected the idea of the phenolic corrosive/lignin linkages; pretty much ether or ester-connected structures, along these lines progressively or conceivably separated. The way that vegetables contain less phenolic acids and that their lignins are less salt solvent may clarify, for example, their weaker powerlessness to soluble base treatment than grasses, minimal known and along these lines hard to evaluate, in nature and the structure of the lignins starting with one animal categories and one assortment then onto the next. This inquiry still needs more key research work with a specific end goal to enhance our comprehension of the degradability of plant cell dividers (Da Silva, 2015).

Connecting the limit of straws to react to basic treatment to its buffering limit (phosphate), to the optical thickness at 280 nm of buffering extricate and to the saponifiable ester linkages of this concentrate (24 straws including 6 cultivars of wheat, rye and triticale were developed in 4 distinctive agro-biological conditions. By and by, the lion's share of both exploratory and field work has prompted prescribe the measurement of 5 kg urea for every 100 kg of straw. Endeavors are being made, basically in China to diminish the measure of urea without losing antacid treatment productive through relationship of lime (Ca (Goodness) 2) with urea. A trail in Vietnam shows that treating with 2.5 % urea in addition to 0.5 % lime and 0.5 % salt gives a similar increment of the straws sustaining esteem contrasted with 5 % urea treatment (Zijistra & Beltranena, 2013).

2.10.5 Span/Encompassing Temperature

The span of the soluble base treatment is longer than the ureolysis procedure. The suggested treatment time ranges from over about two months for temperatures around 5 % to under multi week for temperature over 30 degrees (Sundstol & Owen, 1984).

In established tropical atmospheres, the salt treatment would thus be able to be accomplished following multi week. Be that as it may, in perspective of what has been said before. The term to be suggested by and by ought to never be underneath multi week. As treatment productivity enhances with time it is in any case better to hold up about fourteen days before opening the treatment give the search and rancher's opportunity availabilities permit such a timetable (Sundstol & Owen, 1984).

2.10.6 Air and Water-Tight

Alkali is discharged considerably more gradually from the ureolysis procedure than from an anhydrous smelling salts tank infusion. The dangers of misfortunes of smelling salts in the air are decreased since alkali can tie on the search cell dividers and on the water medium at the same time to its discharge. Anyway just around 1/3 of the smelling salts discharged can tie the plant material, the rest of the 2/3 being in a labile frame and lost, in any case.

This point will be as vital as the capacity is long and the volume of treated material little. The objective without a doubt is to keep up the more anaerobic and ammoniacal environment as conceivable inside the mass of search so as to accomplish the best

treatment as well as the advancement of molds as could reasonably be expected (Chenost, 1995).

2.8 The practice of Urea Treatment

The purpose of this chapter is once the factors controlling the urea treatment have been described, to consider the various practical problems that arise when implementing the urea treatment technique at a practical level. Indeed there is no fixed model technique but rather one which is adapted for the local environmental condition in question.

Strategy and type of treatment depend essentially on; the straw or forage conditioning; loose form, either long chopped; bales, either manually or mechanically made The quantity of forage or straws to treated, depending on the number of animals and the time during which they have to be fed. The farmer's technical skills and facilities and financial situation dictate adoption of the technique. Once treated and if well covered to be maintained in an anaerobic condition, the forage can be stored for several months. It is therefore theoretically possible to treat at one time the quantities required for the whole feeding period. These quantities may however sometimes be too large and necessitate too much labour and space for storage. It is then necessary to treat smaller quantities in successive treatment operations repeated during the feeding period. Depending on the strategy chosen (an optimum compromise between frequency and size) and will result in various types of treatment implying different constraints (Wanapat *et al.,* 2009).

These are essentially fixing up the compromise between the lower costs as possible for the better treatment quality as possible. The former will depend on the use of locally, instead of purchased, materials; the later will essentially depend on the air/water tightness

of the treatment medium. Various types of treatments have been described here and more recently they range from the small pit dug in the soil (only in firm clay and not draining soils) to the classical pressed bales stack covered with plastic sheets as in the anhydrous ammonia treatment, with all the intermediary solutions such as basket or any other containers, various types of clamps, existing construction e.g. storehouse or unused pen (Huhtanen, Rinne & Nousiainen, 2007).

2.8.1 Assessment of the Treatment Efficacy

The best assessment of the treatment efficacy is, of course, the animal response in terms of intake and performances. However, in field conditions, the question is often raised by the extension agents as to how can they be sure, prior to feeding it to the animals, that their treatments were successful when opening the silo they prepared with the farmers. Straws sealed in plastic with 3-pound anhydrous ammonia per 100 pounds hay. The ammonization at a temperature of 72 degrees was complete in 8-14 days. Previous experiments indicate that higher temperature increases the extent of reaction but does not decrease the time required. The nitrogen content of untreated straws, 0.5 % N was increased to 0.9 % N by ammoniation. The ammoniation of straws resulted in a crude protein increase from 3.3 % to 5.6 % and an increase in digestion from 2.9 % to 3.8 % (Kashongwe & Osoo, 2014).

In the detailed controversy linked with the prediction aspects of the feeding value of treated straws and poor quality roughages, we would simply by saying that,

a) The first and simplest criteria of a good treatment is the physical aspect of the treated roughage, marked change of color from clear yellow to brown or dark brown –dark

yellow is not enough, strong but good ammonia smell, without any bad fermenting smell, smooth texture of the straws or the stalks which become easy to twist and to mould absence.

b) a poor alkali treatment is generally associated with a bad N fixation and therefore a low CP content of DM should at least be of 5 % to 6 % points (CP/DM going from 3-4 up to 9 % to 10 %, taking into account the systematic 2/3 loss in the form of labile ammonia that cannot bind). One important point, generally misinterpreted, is that a greater increment is not necessarily synonymous of a good treatment; on the contrary, it should ring the bell of residual urea not totally turned into ammonia because of partial ureolysis and therefore, small ammonia production.

c) The third step, only justified when dealing with relatively high producing animals that must not be fed under their requirements, is to resort to the prediction of digestibility/intake in view of the need of more precision. The classical feed analysis will be no way to be able to predict any feed value. The only, but costly resort is the in Sacco technique or gas test for degradability measurement for feed value prediction, or cellulose or in vitro digestibility technique for digestibility prediction. It is now possible to say that provided some key rules are observed the ‘urea treatment ‘is technically perfectly adapted to the small farmer condition, at both the individual and the cooperative level. A lot of practical field experience has been acquired now in an extremely wide range of agro-ecological and sociological condition with success (Kashongwe & Osoo, 2014).

Hermeticty is less of a concern than with anhydrous ammonia treatment and is not necessarily important when large quantities of plant material are treated the strategic

supplements are urea and minerals. Various ways exist of bringing them to the animal. The older one is utilizing liquid molasses as a carrier. Molasses-urea mixtures are still being used and commercialized in certain countries. Average daily intakes of multi-nutritional blocks from crop residues are 400 g to 800 g for large ruminants, 300 g to 500 g for camels and 100 g to 150 g for small ruminants. With a urea incorporated rate of 5 to 10 %, these intakes allow an N ingestion that covers the N microbial requirement to ferment the potentially degradable. As this degradation is accelerated the actual intake of roughages is increased. As a result of expressing the potential digestibility of the roughage and improving its intake, the physiological status of the animals, its live weight gain or working efficiency or milk production, are improved in a substantial way but, at the same dose of urea, not the same extent as with urea treatment. Such blocks can be manually manufactured by the small farmer himself with the minimum investment (Frost, 1994).

The composition of wheat straws may vary, although this is influenced more by the stage of maturity of the crop at harvesting and environment than by the cultivar grown.

The crude protein of the dry materials is low usually in the range 20 g to 50 g/kg. The rumen degradability of protein is relatively low. The major component of the dry matter is the fibre which contains a relatively high proportion of lignin. The dry matter of wheat straw consists of about 400 g to 500 g/kg of cellulose, 300 g to 500 g/kg of hemicellulose and 80 to 120 g/kg of lignin. The digestibility of the organic matter of these straws rarely exceeds 0.5 and the metabolizable energy value is about 7 MJ/kg DM.

Ash fraction is mainly silica and poor in other sources of essential minerals. Apart from the low digestibility of these straws, a major disadvantage is the low intake obtained when they are given to ruminants unimproved (Mapato *et al*., 2010).

Whereas a 650 kg cow will consume up to 12 kgs of medium quality hay, it will only eat 9 kgs of straws. Improvement in both digestibility and intake can be obtained by addition of nitrogen in the form of urea-ammonia addition. Using urea is regarded as a practical and available method in livestock production, especially in developing countries, as it relatively cheap, adds nitrogen to the ration and is relatively safe to work with especially when dealing with the unskilled workforce. Increasing cost of production has also caused livestock producers to reduce feed costs whenever possible. Low-quality crop residues, because of their availability receive attention and offer considerable potential for reducing feed costs for cattle producers; however because they are low in digestibility, intake by livestock is reduced. Treatment of low-quality crop residue with urea- ammonia improves digestibility or total digestible nutrients (TDN) and increases consumption of these forages (Wanapat *et al*., 2013).

The positive effect of ammonia treatment on digestibility and intake of low quantity forages make them a viable possibility in feeding programs. Straw treatment with anhydrous and aqueous ammonia, urea or other ammonia-releasing compounds has been widely investigated to improve digestibility. The principal of ammonia treatment is supposed to be similar to that of sodium hydroxide treatment. Ammonia treatment not only increases the degradability of the straw but also adds Nitrogen and preserves the straw by inhibiting mould growth. Besides improvement in degradability of structural

carbohydrates ammonia treatment is an effective means of reducing the amount of protein-rich feedstuffs requirement and enhance acceptability and voluntary intake of the treated straw by ruminants. Although comparative studies in improving the energy value of straw have shown that ammonia is less efficient than sodium hydroxide, its use may be more profitable for farmers as the added ammonia serves as a source of nitrogen. In a previous study using cows, treated rice straw packed in polythene bags for four weeks with gaseous ammonia (3 g NH_3 per 100 g dry matter). The excess ammonia was removed before offering the straw to animals (Selim *et al*., 2004).

There are several approaches to improve the nutritive value of crop residues for dairy cattle feeding including improved handling and processing to increase palatability, voluntary intake and digestibility to release nutrients to animals. The treatment increased the Nitrogen content in the straw from 8.16 g to 18.4 g kg -1. Moreover; the physical strength of urea-ammoniated straw was significantly lower than that of the untreated straw. In addition, the proportion of small feed particles tended to be higher and stimulate more attachment and growth of the rumen bacteria. The reduced particle size and the increased attachment sites could lead to subsequent increased microbial colonization and digestion. So, ammonia treatment increases feed value by making the cell wall more available for rumen micro-organism and also the increased nitrogen content improves microbial growth (Plata & Bárcena-Gama., 1994).

Urea is the best qualified for use in smallholder systems in the tropics as it is usually available as a product (ammonium nitrate) with which farmers are familiar. Sufficient urease also is available in the tropics due to a warm environment and ensure the

breakdown of urea to ammonia. Urea breaks down the lingo-cellulose bonds of the residue, increasing rate and extent of rumen microbial digestion, improves the nitrogen status of the residue. It is also relatively safe and easy to use, easy to transport, no cultural reason to prohibit its use and no damage to the environment. It is now possible to say that provided some key rules are observed, the urea treatment is technically perfectly adapted to the small production units, at both the individual and the cooperative level. Much practical field experience has been acquired now in an extremely wide range of agro-ecological and sociological conditions. Sealing is less of a concern than with an anhydrous ammonia treatment and is not necessarily important when large quantities of plant materials are treated (self-covering). Animal response to urea treatment is similar to the anhydrous ammonia treatment achieved at the same alkali level. This response is optimum with mean yielding animals making them the target animals (Wanapat *et al.*, 1991).

2.8.2 Supplementation of Treated and Untreated Poor Quality Roughages

An appropriate supplementation to poor quality roughages should first favor the rumen cellulolysis, then enhance rumen microbial synthesis and supply the animal with the required nutrients for maintenance and, when necessary, for production, bearing in mind that these nutrients cannot be compared with those expected with good forges (Selim *et al*, 2004).

2.8.3 The Catalytic Supplementation for Subsistence or Modest Production

The first step in supplementation is the catalytic step which ensures a good cellulolytic rumen ecosystem by supplying non-protein nitrogen (NPN) and minerals. Such

supplementation hardly covers the maintenance requirements of the animals. The strategic supplements are urea and minerals. There are two ways of giving them to the animals. The older way is to use liquid molasses as their carrying medium. Molasses-urea mixtures are still being used and commercialized in some countries and contain 3 % urea and minerals. It is distributed at a rate of 0.5 kg/day/100 kg live weight. Amore convenient practice, developed by the FAO, that is becoming popular throughout developing countries, is the multi-nutritional block the carrying medium is solid and therefore easier to transport (Del Coco & Bilbao, 2014).

The block is licked by the animal, which ensures a small progressive and regular intake of urea. Molasses can even be substituted for other ingredients e.g. lime clay and/or cement. These blocks provide the opportunity of utilizing any type of locally available agro-industrial by-products e.g. brans pulps poultry litter which provide the animal with other nutrients sources than urea and mineral which are fundamental. Average daily intake is 400 g to 800 g for large ruminants, 300 g to 500 g for camels and 100 g to 250 g for small ruminants. With urea incorporation rate of 5 % to 10 %, these intakes allow a nitrogen ingestion that covers the nitrogen microbial requirement absolutely necessary for the fermentation of the potentially degradable organic matter contained in the straw or roughage fed or grazed.

As this degradation is accelerated the actual intake of roughage is improved. As results of expressing digestibility of the roughage and improving its intake, the physiological status of the animal, its live weight gain, working efficiency or milk production, is improved in a substantial way. Such blocks can be manually manufactured at the village

or cooperative level or by the small farmer himself with minimal investment (Lohan, 2005).

2.9 Supplementation for a Higher Production Level (Untreated and Treated Poor Quality Roughage)

The second step in supplementation concerns the host animal, where the catalytic supplementation becomes inadequate to sustain some more production than the maintenance. This supplementation should;

a) Be as cellulolytic (digestible cell walls) as possible to avoid any negative digestive interaction and too high a substitution of the roughage for the supplement.

b) Be given in such amount that the major part of the diet is constituted by the basal poor quality roughage (2/3 when supplementation is rich in starch, (1/2 when supplementation is rich in digestible cell walls).

C) Bring a maximum amount of digestible nutrients to the intestines (without having gone through ruminal fermentation) to satisfy the animal's productive needs so that there is a synergic effect on poor quality roughage utilization. Point *a* and *b* are particularly important in the case of treated poor quality roughage if one does not want to lose the benefit of the treatment lost because of negative digestive interactions (Mahesh & Mohini, 2013).

For socio-economic reasons supplementation should be ensured by as much local feed resources as possible and avoid the use of classical concentrates (or their components, earmarked for human and non-ruminant nutrition, i.e. cereals and high-quality oil cakes. Contrary to conventional supplements, the main strategic supplements, consist of farm

residues such as haulms and leaves of pulse crops and vegetables, these provide green or digestible matter of plant origin and of course vitamins and their nitrogen concentration is high (Wanapat *et al*, 1991).

Urea treatment and nutritional blocks represent the simplest and easiest way of optimizing poor quality roughage in ruminants. They are now widely used in practice or their used is coming to effect. Recommendations given relative to urea treatment should not be followed rigidly but, to the contrary, should be reasoned and adapted to the agro-ecologic conditions in which the treatment is carried out. Improved knowledge of the capacity of straws to respond to alkaline treatment should allow the modulation of the urea dosages to be used to improve the efficiency of the treatment. This capacity, unfortunately, remains difficult to predict because there are no simple or reliable criteria. More attention should be paid to the use of locally available feed resources as synergic supplementation of poor quality roughage, either treated or untreated. For instance, the relatively poor quality of the nitrogen generated via treatment justifies the importance of correct reasoning of the quality and, above all, the nature of the nitrogen complement in treated forages. Development measures followed along with extension programs of such techniques, and agro-economical and sociological considerations regarding rate if adoption and impact of such techniques deserve the utmost attention when launching poor quality roughage- based development programmes based on poor quality roughages (Del Coco & Bilbao, 2014).

2.10 Simplification of Urea Treatment

Endeavors were made in the past to enhance the edibility and protein through compound treatment. In this association, sodium hydroxide was utilized which brought about enhancing the absorbability, however its utilization stayed constrained because of a staggering expense of substance and natural contamination. The other compound utilized was anhydrous smelling salts which enhanced the edibility and expanded the nitrogen substance of the treated straw yet non-accessibility of alkali gas in the basic market and its transportation through specific holders restricted its utilization. Of late, manure review urea has been utilized for this reason (Cromwell, Kellems & Church, 1998).

Urea is less expensive, effortlessly accessible and thought to be equal to anhydrous or fluid smelling salts for redesigning oats straws in the hotter districts of the world. In any case, the reception rate of this method stayed low. One reason might be the generally dull innovation and high necessity of work. There is a requirement for the strategy for treatment to be disentangled, with least inclusion of work. A few specialists revealed that the urea treatment process would be mainstream in the event that it is essentially down to earth and the material to be utilized in the treatment is accessible on the homestead. Aftereffects of concentrates on dampness level demonstrate that as the level of water is expanded from 10-100 % of the protein substance of straw expanded from 3.3 % to 9.68 % (Jabbar, 2009).

These qualities were very near that of the regular technique where 100% water was utilized for the urea arrangement blended with the straw. This showed the expansion of water is essential for greatest protein action. Despite the fact that it has been accounted

for that urea treatment of straw is conceivable even with dry wheat straw, the protein rate stays low, in light of the fact that the lower diminishes the hydrolysis of urea to alkali and authoritative of nitrogen to fiber (Mapato *et al.,* 2010).

Length of brooding demonstrates that as it expanded from multi week to about two months the rough protein esteems additionally expanded. The outcomes were in concurrence with the discoveries of prior analysts. The protein rates in the traditional technique were greatest at about two months (6%) whereas in the new strategy the always expanding pattern was up the fifth week (4.56%), and from that point onward, it didn't increment altogether. From this pattern, we can infer that relying on surrounding temperature, a hatching time of three to about a month and a half is adequate. Urea treatment enhances edibility, admission and unrefined protein substance of the straw. The degree of reaction to urea treatment regarding straw quality is variable, because of variety in beginning straw quality, species distinction among straw and stovers, and the kind of creatures utilized for tests (Grag & Bhanderi, 2011).

The expansion in rough protein content caused by urea treatment is in the request of 4-5 rate units, because of the expansion of smelling salts. Rough protein content increments are higher than what might be required in connection to the expanded absorbable vitality accessibility in the rumen. The higher absorbability and admission is basically caused by the expanded rate and degree of cell divider corruption. For the most part, it very well may be said that by supplanting a lot of untreated straw by treated straw in the proportion; the butterfat tends to expand, drain yield increments of 1.5 liters are accounted for, yet

0.5-1 liter give off an impression of being a sensible range contingent upon different feeds, phase of lactation and body weight of the creature.

Creatures of 100-150 kg body weight will lose 50-100 g/day whenever encouraged on untreated straw, while they will pick up 50-100 g/day when bolstered on treated straw (Jabar, 2009)

2.10.1 Lime treatment

Lime Cao/Ca (Goodness) 2 is a feeble antacid operator with low solvency in water. It has been accounted for that lime can be utilized to enhance the use of straw and furthermore be utilized to supplement the proportion with calcium, which has been observed to be in negative equalization in cows sustained on unchanged just straws. Dousing and ensiling are two techniques for treating straw with lime. In spite of the fact that lime medications increment the degradability of straw, the dry issue admission diminishes, because of a decreased worthiness of the treated feed by creatures. Ensiling straw with 4 or 6% Ca (Gracious) 2is adequate in treating straws. It was proposed that a mix of lime and urea would give preferred outcomes over urea or lime alone. This blend has the upside of an expanded degradability and an expanded substance of both calcium and Nitrogen (Chenost, 1995).

Added substance impacts of lime and the other antacid specialists have been illustrated. The utilization of lime might be more secure and more financially savvy to use than

sodium hydroxide (NaOH). Essentially, these antacid operators can be consumed into the phone divider and artificially separate the ester securities between lignin, hemicellulose and cellulose, and physically make the basic filaments swollen. These procedures empower the rumen small scale life forms to assault all the more effectively the auxiliary starches, improving degradability and tastefulness of the straws .the way toward restoring will empower arrival of supplements to creatures and to be a helpful option in contrast to the ranchers in their generation frameworks (Selim et al., 2004).

2.10.2 Estimation of Straw Admission

In the three preliminaries, the straw was weighed at each bolstering. Buildups were gathered and weighed before the morning feed each day for the entire nourishing trail time frame. Natural issue consumption (OMI) of straws was resolved in light of the every day measure of straw encouraged, buildups and their dry issue and slag substance decided. On account of slow down bolstered straws and other low-quality scavenges, we, in this manner, guessed that the amount of straw expended would increment if the sum offered was expanded to enable creatures to reject more than the rate of 10 %-20% of the sum offered, ordinarily embraced in adlibitum nourishing preliminaries. Our examination has meant to characterize how much straw should be offered to ruminants to empower them to choose the more nutritious segment of straw and furthermore to eat more. The consequences of a few investigations displayed show the degree to which admission of harvest deposit can be controlled by the sum offered and by physical preparing and

measure of supplement. This is valid with most little ruminants yet with cows, admission was not changed by the quantity of straws offered (Highstreet, 2010).

2.10.3 Impact of Measure of Focus Supplement

Admission of straw at the low-off-rate of straw in addition to low-supplement was the same as the admission of straw at the high-offer-rate of straw in addition to high-supplement. The outcomes exhibit that straw admission might be controlled by both measure of buildup offered and measure of supplement. Some dairymen feed little measures of straws when each draining with investigate results supporting enhanced dry issue admission and yield of drain, protein, and lactose. Nourishing individual dairy animals as per drain generation is the most proficient utilization of feed however requires included work or computerized hardware. Real changes ought to be made in little additions over at least a little while to permit rumen microbial populaces to adjust to evolving nourishes (Robison et al, 1994).

2.10.4 Compound Investigation

Crisp examples of the diverse kinds of straws are dissected for nitrogen substance and measures of urea included before bolstering. Agent tests of treated straws at various levels of urea and untreated straws are broke down for dry issue (DM) and aggregate fiery debris (Smith & Williams, 2016).

CHAPTER THREE: MATERIALS AND METHODS

3.1 Experimental Site

The study was carried out on a dairy farmer's farm Sotik Sub-county of Bomet County, Kenya. The area is among the places within the former Rift Valley Province of Kenya that is known to be of high potential for dairy production. The site is located 300 km West of Nairobi, the capital city of Kenya and 10km from Bomet town. The place is situated at an altitude of 1800 m above sea level, $9^{0}3$, North and 38^{0} 38' East longitude. It receives an annual rainfall of about 2100 mm with an average maximum temperature of 21.3 ^{0}C.

3.2 Selection of Experimental Dairy Cows

Three Friesian dairy cows in their second calving and mid-lactation with 350±1 kg body weight were selected for each treatment from the farmer's dairy stock. These cows were selected such that their milk yield was very close to each other within ±0.05 kg/day.

3.3 Experimental Design

A 3 x 3 Latin Square Design was used for handling the experiment. The experimental dairy cows were allotted at random to three groups: A, B and C for continuously cured, single batch cured and untreated wheat straw feeding groups respectively at the start of period one, than in periods two and three. The average milk yield for the three groups was 8.394 kg/day for group A 8.429 kg/day for group B and 8.387 kg/day for the group. Three treatments: continuously cured, single batch cured and untreated wheat straws were the experimental feeds. The experiment was conducted for three periods, 28 days each. In

each period 7 days for adaptation and 21 days for data collection was allotted. The experimental design layout was as shown in Figure 3.1.

			Feeding Periods		
Lactating Friesian Dairy Cows	Feeding Group	Cow No.	P1	P2	P3
	A	1	CC	SB	UN
		6	CC	SB	UN
		8	CC	SB	UN
	B	2	SB	UN	CC
		4	SB	UN	CC
		9	SB	UN	CC
	C	3	UN	CC	SB
		5	UN	CC	SB
		7	UN	CC	SB

Figure 3.1 **Experimental design layout**

Key:

A – Feeding Group A

B – Feeding Group B

C– Feeding Group C

CC – Continuously Cured Wheat Straw

SB – Single Batch Cured Wheat Straw

UN – Uncured Wheat Straw

P1 – Period One

P2 – Period Two

P3 – Period Three

3.4 Experimental Procedure

Wheat straws were chopped using a bulvarizer chaff cutter so as to achieve required sizes of between 0.5-1.5 cm. Chemical treatment of the wheat straws involved adding 5 kg of urea and 6 kg of lime ($CaCO_3$)in 100litres of water to 100 kg air-dry wheat straw. Using a watering can, the treatment solution (Urea+ $CaCO_3$) was then sprayed onto a stack of 100 kg chopped wheat straw placed on a polythene sheath spread on the floor. The treated straws were manually mixed thoroughly then packed by compressing in silage tubes and covered making them air-tight and ensiled for 21 days (single batch curing). For continuous curing process, half of the treated and ensiled wheat straws were removed after 21 days and an equal amount of freshly treated wheat straws added and mixed thoroughly to achieve a homogeneous form. The half ensiled half fresh wheat straws were then ensiled for one week (7 days).

After 3 weeks of ensiling (for a single batch) and 1 week for continuously cured wheat straws, treated straws were taken out from the silage tubes as per the daily feed ratios of 10 kg per cow. The cows were fed with treated wheat straw after exposing the ensiled material to air for 2 hours to avoid inhalation of ammonia by the animals. Untreated wheat straw was fed immediately after taking out from the barn. The experiment was run in three periods, each lasting for 28 days of which first 7 days at the start of the experiment and in between the periods were the cows' adaptation to the changed feed, and milk yield and feed intake was monitored for successive 21 days. Introduction of treated wheat straw was gradual. The cows were given clean fresh water and mineral salts adlibitum. The cows were housed in individual pens and kept completely under stall feeding conditions. All other management practices were similar as far as possible.

3.5 Measurement, Sampling and Data Recording

Experimental cows were monitored and closely observed throughout the experimental period. Morning and afternoon milk produced by the experimental cows were measured and total milk yield per cow was recorded daily for 21 days in each experimental period (63 days in 3 periods). Data were also recorded for the feeds offered and left, daily intakes of continuously cured, single batch cured and untreated wheat straw. Samples from each feed treatment were taken every day, pooled to a weekly basis and ultimately composited by period for nutrient content analysis.

3.6 Data Analysis

To determine the effect of wheat straw treatment on daily dry matter intake and milk production from the 28 days data in each period, data of the 21 days excluding the first 7

days data were used for analysis. Dry matter intake and daily milk yield were subjected to Analysis of Variance using General Linear Model (GLM) procedures of Statistical Package for Social Sciences (SPSS 24). The statistical model used was:

$$Y_{ijk} = \mu + r_i + c_j + t_{k(ij)} + e_{ijk}$$

Where:

Y_{ijk} - Dependent variable (feed intake, milk yield)

μ = Overall mean

= Effect r_i of lactation stage (Period effect)

c_j = Effect of cows (column effect)

$t_{k(ij)}$ = Effect of feed treatment

e_{ijk} = Error term

The treated samples for single and continuous batch processes will be grounded using a hammer mill and passed through a 1mm screen. These samples are to be analyzed for dry matter, total ash and crude protein according to Association of Official Analytical Chemists (AOAC) Dietary Supplements SLV Guidelines (2012).

CHAPTER FOUR: RESULTS AND DISCUSSION

Introduction

The experiments were conducted to study the effects of single and continuous curing of wheat straws on feed intake, dry matter (DM) digestibility and milk yield of lactating dairy cows under a single farmer's management conditions in the Bomet County of Kenya. In this chapter, the results of analysis of data collected from the experiments are presented and discussed as per the objectives of the study. Samples of diet were chemically analyzed for dry matter (DM), crude protein (CP), fat, neutral detergent fibre (NDF), acid detergent fibre (ADF) and ash following the methods of Association of Official Analytical Chemists (AOAC) Dietary Supplements SLV Guidelines (2012).

4.1 Effects of single and continuous curing of wheat straw on nutrients' availability

Table 4.1

Effect of Urea Treatment on Wheat Straw Nutrients

Parameters	**Nutrient Composition (%)**	
	Untreated wheat straw	**Urea-treated wheat straw**
Dry Matter	61.7	91.3
Crude Protein	2.9	13.7
True Protein	1.2	8.1
Neutral Detergent Fibre	82.8	70.3
Acid Detergent Fiber	44.6	59.9
Gross energy	**1.51**	**1.03**

As the results in table 4.1 shows, wheat straw contained 2.9 % crude protein which was increased to 13.7 % by treatment with 5% urea and ensiling, which were about 10 units higher. Similar findings were reported by Meyer *et al.,* (2010) and Rauch *et al.,* (2014). The neutral detergent fibre content decreased from 82.8 % to 70.3 % possibly due to solubilization of hemicellulose content during treatment. On the other hand, the ADF content increased from 44.6 to 59.9 units. The increase of ADF may be due to consequences of a reduction in hemicellulose.

4.2 Effects of single and continuous curing of wheat straw on dry matter intake

The mean daily dry matter intake of single and continuously cured as well as uncured wheat straw was determined and the results presented in Table 4.2.

Table 4.2

Daily DMI of Cured and Uncured Wheat Straw by Lactating Cows

Treatment	**Dry Matter Intake**			**95% Confidence Interval**	
	Mean	**Std. Deviation**	**Std. Error**	**Lower**	**Upper**
Continuously Cured	6.040	.7085	.053	5.933	6.149
Single Batch Cured	5.998	.5439	.039	5.919	6.075
Uncured	4.201	.2449	.018	4.166	4.234

The highest mean daily dry matter intake (DMI) was noted when lactating dairy cows were fed on continuously cured wheat straw (6.04 kg), which numerically differed

marginally with the mean DMI of the cows when they were fed on single batch cured wheat straw (5.998 kg). The mean daily dry matter intake when the cows were fed on uncured wheat straw was lowest at 4.20 kg. The difference between daily DMI of continuously cured and single batch cured wheat straw was 0.42 %. On the other hand, the difference in daily DMI intake between continuously cured and untreated/uncured wheat straw was 18.39 % while the difference between single batch cured and untreated/uncured wheat straw was 17.97 %. Results of Analysis of variance (ANOVA) were as shown in Table 4.3.

Table 4.3

ANOVA Tests of Between-Subjects Effects for Dry Matter Intake

Dependent Variable Dry Matter Intake

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Feeding Group	3.485	2	1.743	6.882	.001
Treatment	411.175	2	205.588	811.860	.000
Error	139.530	551	.253		

Analysis of variance (ANOVA) revealed that wheat straw DMI was significantly different between the treatments ($P < 0.05$). Following post-hoc analysis utilizing LSD test (Table 4.4), it was established that there was no difference in DMI of continuously cured and single batch cured wheat straw. However, DMI of both continuously cured and single batch cured wheat straw were found to be significantly higher that DMI of

untreated wheat straw ($P < 0.05$). These results implied that curing increased dry matter intake of wheat straw by the lactating cows and that continuously and single batch cured wheat straw produced similar effects on the lactating dairy cows. There was a consistent increase in DMI whenever the lactating cows were fed on continuously cured and single batch cured wheat straws. Conversely, the DMI consistently declined whenever the cows were fed on uncured wheat straw.

Table 4.4

LSD test results for wheat straw treatment and DMI

Treatment	CC	SB	UN
CC		**0.042**	**1.839***
SB			**1.797***
UN			

*. The mean difference is significant at the 0.05 level; CC: Continuously Cured: SB: Single Batch Cured: UN: Uncured

Dry matter intake of wheat straw was not significantly affected by the different feeding groups and wheat straw treatment as shown in Figure 4.1.

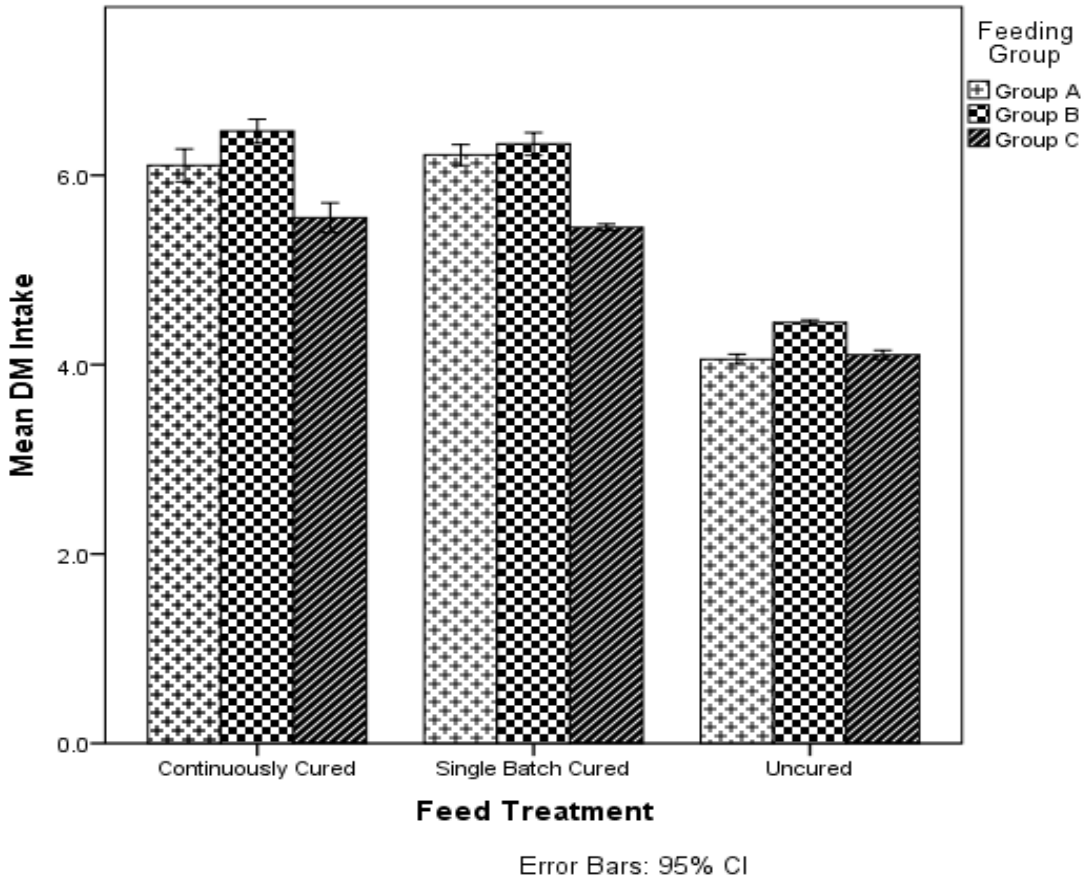

Figure 4.1 **Effects of Feeding Group and Feed Treatment on Dry DMI**

The findings in this study are consistent with the findings of Meyer et al., (2010) and Huhtanen *et al.*, (2007) whose investigation revealed that there was the exceedingly noteworthy distinction in change on DMI when dairy animals were nourished with urea-calcium hydroxide and urea-treated rice straw contrasted with the untreated treatment. Qingxiang (2002) additionally found that the treatment of urea and calcium hydroxide could somewhat expand DMI in dairy bovines when contrasted and untreated rice straw (Mesfin & Ktaw, 2010) likewise revealed that dairy cows nourished on urea treated wheat straw devoured altogether higher aggregate dry issue than those encouraged on untreated warmth straw.

The generally higher DMI of treated wheat straw contrasted with untreated implies that treating the wheat straw with urea and calcium hydroxide upgraded the viability of admission of the wheat straw. The expansion in treated wheat straw admission under the present investigation might be credited to its expanded degradability in the rumen as clarified by Smith (2001). Urea discharges smelling salts in the wake of dissolving in water. Then again, calcium hydroxide is a feeble soluble base operator with a low solvency in water and is utilized to enhance the use of straw and furthermore to supplement the apportion with calcium, which has been observed to be in a negative equalization in dairy cattle sustained just on straw. The mix of lime and urea builds degradability of wheat straw, clarifies the high DMI of treated wheat straw in the present examination (Wanapat *et al*., 2009).

4.3 Effects of single and continuous curing of wheat straw on milk production

The initial milk production of the 9 lactating dairy cows, in their mid-lactation, was such that their milk yield was very close to each other within ±0.05 kg/day which was not significantly different. The initial mean yield for each group of three cows that were randomly allotted to the different feeding groups was determined as A = 8.394 kg/day; B = 8.429 kg/day and; C = 8.387 kg/day. At the end of the experiment, the mean daily milk production by lactating dairy cows fed on differently treated wheat straw was determined and the results presented in Table 4.5.

Table 4.5

Mean daily milk (kg) of cows fed on cured and uncured wheat Straw

Treatment	Mean	Std. Deviation	Std. Error	95% Confidence Interval	
				Lower	Upper
Continuously Cured	10.255	1.4871	.1090	10.056	10.443
Single Batch Cured	9.958	1.247	.0914	9.780	10.124
Uncured	8.414	1.7881	.1311	8.175	8.667

The results at the end of the experiment revealed that average daily milk production increased by 22.14 % when the lactating cows were fed on continuously cured wheat straw, 18.57 % when fed on single batch cured wheat straw and an insignificant 0.12% when fed on uncured wheat straw. Analysis of variance results showed that milk yield significantly different with different feed treatments fed to the lactating dairy cows at $P < 0.05$ as shown in Table 4.6.

Table 4.6

ANOVA tests of between-subjects effects for Milk Yield

Dependent Variable: Milk Production					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Treatment	365.126	2	182.563	134.525	.000
Feeding Group	149.005	2	74.502	54.898	.000
Error	747.759	551	1.357		

Milk yield of lactating cows also differed significantly by feeding period and feeding groups, confirming that changes in feed treatment induced significant effects on milk production due to the transition. The results of post-hoc analysis utilizing LSD test to determine where the significant differences in mean daily milk yield based on differences in wheat straw treatment were as presented in Table 4.7.

Table 4.7

LSD test results for wheat straw treatment and daily Milk Yield

Treatment	**CC**	**SB**	**UN**
CC		0.0297*	1.841*
SB			1.544*
UN			

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

LSD post-hoc results revealed that there was a significant increase ($p<0.05$) in the milk yield of lactating dairy cows in their mid-lactation when the cows were fed on differently cured wheat straw. Most significant differences were realized when the lactating cows were fed on both continuously cured (1.84 kg) and single batch cured (1.54 kg) wheat straw compared to the period when the cows were fed on untreated wheat straw. The mean difference in daily milk yield between the periods when the lactating cows were fed on continuously cured and single batch cured wheat straw were significant with a marginal numerical mean difference of slightly over a quarter a kilogram of milk in favour of continuously cured wheat straw. Mean daily milk production was not significantly affected by the feeding group and wheat straw treatment as shown in Figure 4.2.

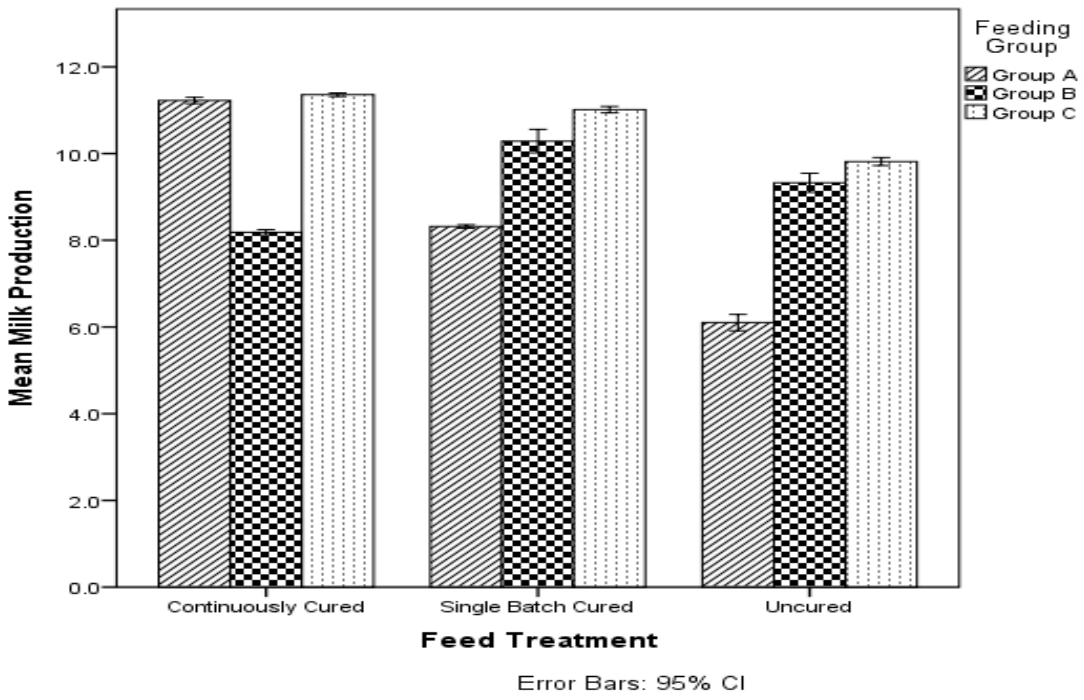

Figure 4.2 Effects of feeding group and Feed Treatment on milk Production

The foregoing results were consistent with the finding of Wanapat et al., (2009) who reported that treated straw with urea improve feed intake and digestibility, leading to an increase in milk yield (Mapato *et al*., 2010) found an increase in milk yield when dairy cows were fed on urea treated straw. Mesfin and Ktaw (2010) also reported similar results, that cows fed on the urea treated wheat straw based diet had higher mean daily milk yield than cows fed untreated wheat straw based diet.

The increase in milk yield when the lactating dairy cows were fed on cured wheat straw may be attributed to increased nutrient content in the treated wheat straw and higher intake and digestibility of the treated straws. This is because urea treatment increases crude protein through added non-protein nitrogen (NPN) and enhances digestibility through delignification. Increased milk yield may also be due to increased total DMI when urea treated straw was fed to the experimental lactating cows. Besides, urea treatment might have changed the intrinsic properties of wheat straw for higher energy yields might have been utilized for increased milk production.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The objectives of this study were to determine the effects of urea treatment of wheat straw on nutrients available in the feeds and determine the effects of a single batch and continuous curing of wheat straw on dry matter intake and daily milk production of lactating dairy cows. First, with regard to nutrients availability, the study concludes that urea treatment of wheat straw resulted in increased crude protein by 10 % units, an increase in acid detergent fibre content by 15 % units and a reduction in neutral detergent fibre content by 13 % units.

Secondly, with respect to the effect of effect of a single batch and continuous curing of wheat straw on dry matter intake by lactating dairy cows, the study concludes that there is no statistically significant difference in dry matter intake of wheat straw between single batch and continuous curing of wheat straw. However, urea treatment of wheat improves dry matter of wheat straw since there were significant differences in the amount of dry matter intake between treated and untreated wheat straw.

Finally, in terms of the effect of a single batch and continuous curing of wheat straw on daily milk production of lactating dairy cows, it is concluded that urea treatment increases average daily milk production increased by approximately 20 %. However, the average differences are not statistically significant whenever the lactating cows are fed on continuously cured and single batch cured wheat straws.

5.2 Recommendations

Urea treatment of wheat straw improves the nutritive value, digestibility and milk production of lactating dairy cows. It is therefore recommended that dairy farmers should endeavour to utilize this technology to improve not only feed utilization efficiency of their dairy stock but also milk production which will ultimately lead to economic efficiency and higher profit margins.

The non-significant differences between dry matter intake and average daily milk production of lactating cows when fed on either single batch of continuously cured wheat straw serves to advise dairy farmers that they should judiciously adopt continuously curing model which reduces the time taken to have the cured feeds available for consumption by dairy cattle.

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