Factors Affect Nutritional Value of Tropical Pasture

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Abstract: The nutritional value of tropical pasture is discussed in relation to the poor performance of grazing animal’s particularly dairy cows. The voluntary intake of tropical legumes is usually higher than that of tropical grasses when fed to sheep indoors, due to a shorter retention time in the rumen and a greater packing density. Forage grown under higher temperature condition is usually lower in quality that grown under cooler temperatures. One reason is that lignin deposition is increased by higher temperatures. Also, cooler growth temperatures lead to the accumulation of sugars and other non structural carbohydrates. Animal production from cattle grazing tropical pasture swards and factor limiting production are considered in relation to variation with in species that cool region grass high digestibility than warm region grasses, between species legumes high nutrient value than grass, stage of maturity young stage have high nutritive value than old or mature, intensity of grazing cutting when the pasture cutting frequency decreases the forage yield increases while forage quality declines, type of soil PH is the first guide to mineral availability and the possibility of nodulation, fertilizer application a high rate of nitrogen fertilizer is necessary to maintain the high productivity, harvest and storage condition in the form of hay and silage can lower the value than standing crops environment with high temperature also affect or lower the nutritive value of forage. The effect of seasonal difference throughout the year is demonstrated by comparing seasonal variation in milk production, toxic and undesirable compounds also influence the product. So the nutritive value or pasture quality mainly determined by many factors those affect the plant digestibility. The aim of this paper is to understand how to obtain good nutritional value from tropical pasture and how to manage.

Keywords: Nutrition, Tropical, Voluntary, Temperatures, Productivity.

1. INTRODUCTION

The nutritive value of forage refers to its composition, digestibility and the nature of digested products. The amount of forage consumed by the animal is very important, as it affects total nutrient in take and there fore the animal response presence of a component in the plant does not necessarily mean that it is readily and completely available to the animal ingesting the herbage. Its level of consumption and digestion as well as an estimation of the actual need by the various classes of animals are the major factors that have to be considered while determining the usefulness of the forage to the animal (Crowder and Chheda, 1982).

A grass sward is of high nutritive value when it has both the chemical and physical characters to ensure high animal intake and production. Nutritive value is subject to fluctuation due to plant (growth
stage; herbage yield) and husbandry factors. Thus it is not an obsolete, but a relative character and should be viewed in a permanent prospective of these factors. As ward is high and uniform in quality but low in yield when constantly harvested young. The measured to be considered are species and husbandry. Traditionally, nutritive value has been interpreted in terms of chemical composition of minerals but in particular of crude protein and crude fiber. Most of the analytical data of the work done in East Africa refer to the chemical composition of this kind (Boon man., 1992).

Many factors affect the value of pasture including the type of soil and level of fertilizer application, the plant species selected and the stage of maturity of the plant and the intensity of grazing. The chief benefit from applying fertilizer to pasture is an increase in yield. In grass legume pastures, proper fertilizing can influence the proportion of legumes in turn this increases the protein, calcium, phosphorus, and vitamin content of the mixture generally, require nitrogen (N) fertilization. However is important to maintain adequate of lime, phosphorus (P), and potassium (K) in the soils of these pasture properly fertilized pasture plants begin growth earlier in the spring and continue growth later in the fall, thus extending the grazing season (Tyler and Ensminger, 2006).

There are three primary factors affecting forage quality in most situations. These are forage species, maturity stage and harvesting conditions. Secondary influences include temperature and soil moisture during growth, soil fertility and cultivar. Many of these factors influence forage quality because they affect plant anatomy and morphology (Robert et al., 2003).

The quality of forages ingested by dairy caws grazing pasture is determined by the quality of the pasture and the ability of the animal to select its diet form the materials on offer. The nutrients actually available to the animal will depend on digestion and absorption in the rumen and intestine. A natural pasture is generally a complex mixture of many species, all of which have their own nutrient profile. Sown pastures, on the other hand are generally simple mixtures with components that have been selected as having higher nutrient profile than those found in naturalized or native pasture species. Single species forage provides even less variability and choice, particularly in situations where soil nutrients are limiting or environmental pressure restrict optimum growth. A plant community will have plants at different stage of maturity and these plants have different proportion of leaves, stems, and seed heads which will also vary in their nutrient profile (Roginiski et al., 2002).

The aim to review and to understand how pastures nutritional value affected by many factors and how to obtain good nutritional value or good quality pasture.

2. LITERATURE REVIEW
2.1 Factors affect nutritional value of pasture in tropics
2.1.1. Plant species

Forage species can differ markedly in forage quality. In general legumes are higher in quality than grasses but exception occurs. Large difference also exists among grasses and among legumes in forage quality. One survey of forage grasses found that cool-season grasses average about 13% higher in digestibility than warm season grasses. Leaf cross sections of Bermuda grass show a greater percentage of the area occupied by less digestible vascular bindle, epidermis, and sclerenchyma tissues than for tall fescue. Conversely, Bermuda grass had a lower proportion of highly digestible mesophyll cells than did tall fescue (Akin and Burdick., 1975).

Plant spices affect the feeding value of pasture. Generally legumes contain a higher percentage of protein and calcium than do non legumes. The percentage of lignin and fiber in plant influences both palatability and digestibility. Although inherent differences exist among plant species as well as among plants of the same species, young plants and growth are always lower in fiber and lignin than are mature plants. As a result they are more tender and digestible. On a dry matter basis new growth in a grass legume pasture ranges up to 68 percent total digestible nutrients in comparison with 51% at the normal hay stage. In humid areas the nutrient content of some grasses is leached rapidly following maturity and the digestibility and nutrient value is greatly reduced. To a considerable degree, the decrease in digestibility as plants mature is due to an increase in lignifications, which lowers digestibility (Tyler and Ensminger, 2006).

Clovers were valued in comparison with grass for their relatively high concentrations of protein and of several mineral elements, particularly Ca. When fertilizer N and mineral supplements become widely available, these features were of less importance but other nutritional qualities of clovers were
recognized. The content of cell wall material is lower in the clovers than grasses, and there are differences in the composition of the cell wall with the result that patterns of digestion are also somewhat different. The protein of clover is utilized more efficiently by the microorganisms in the rumen and consequently, at equivalent intake of organic matter, the amount of protein entering the duodenum is considerably greater with clover than with grasses. This results in greater absorption of amino acid by the animal from clover than from grass (Whitehead., 1995).

Table 1. Components (% in dry matter) of the herbage of perennial ryegrass (CV. Mille) and white clover (CV) harvested at similar digestibility

<table>
<thead>
<tr>
<th>Components</th>
<th>Ryegrass</th>
<th>Clover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>2.8</td>
<td>4.4</td>
</tr>
<tr>
<td>Cell wall material</td>
<td>42.7</td>
<td>21.6</td>
</tr>
<tr>
<td>Cellulose</td>
<td>24.0</td>
<td>17.3</td>
</tr>
<tr>
<td>Hemicelluloses</td>
<td>16.1</td>
<td>0.8</td>
</tr>
<tr>
<td>Lignin</td>
<td>2.7</td>
<td>3.8</td>
</tr>
<tr>
<td>Pectin</td>
<td>0.8</td>
<td>4.0</td>
</tr>
</tbody>
</table>


2.1.2 Legume

The voluntary intake of tropical legumes is usually higher than that of tropical grasses when fed to sheep indoors, due to a shorter retention time in the rumen and a greater packing density. A delving legume to pasture would be expected to increase live weight gain and milk production and should that beef production was proportional to the proportion of legume in the sward. Similarly a laubl pursuer was able to maintain a relatively high production in contrast to tropical grasses and good milk production has been obtained from cow and grazing leucaena leucophala. Tripholium semipilosum based pastures have proved to be quite out standing with milk yields from Jersey cows averaging 16 kg cow/day over extended periods and have also consistently produced high live weight gains indicating the high nutritive value of this species. However, lower milk production has been obtained from cows grazing pure stands of siratro and green leaf Desmodium (Desmodium intortum) compared with nitrogen fertilized pangola, possibly due to the difficulty cows have in harvesting the leafy fraction of the legume cows grazing green leaf desmidian produced more milk than cows grazing siratro despite a lower invitro digestibility which may have been caused by tannin (McLeod., 1975).

2.1.3 Grasses

Large differences in digestibility and intake are to be found between and with in topical grass species when fed to sheep in pens. Smaller but still substantial differences in the ability of tropical pastures to supply nutrient for milk production have been measured. Dignitaries decumbent has consistently proved superior to other tropical grass pasture because of a higher in take of digestible energy when cows graze this pasture reason for this higher intake are not clearly understood but could be related to the high soluble carbohydrate content in pangolin herbage. Only one critical beef experiments aimed at measuring the potential nutritional value of six tropical grass species, using the lenient grazing pressure technique has been conducted. Over the first year of the experiment steers averaged 0.48 kg/steer/day with highest production from setaria accepts cv. Narak and setaria splendid compared with animal performance from digitaria decumbent, setaria anceps CV. Kazungula and pennisetum clandestinum. In subsequent years difference in animal production from steers grazing these species were small indicating that there is little variation in feeding quality between these grasses. Levels of production were however lower than from cattle grazing some of these species in other aperients (Evans and Bryan., 1970).
2.2. Stage of Maturity

There are marked differences exist between different finds of pasture plants as growth advances. Most pasture legumes retain their palatability and nutritive value better as they mature compared to most grasses, an exception is lespendeza serica, which becomes bitter and distasteful with maturity due to the accumulation of tannin in the plants. However, plant breeders have developed sericea that is low in tannin there by over coming this problem to some degree. The effect of pasture maturity up on animal production is recognized by every farmer and as far as practicable he attempts to feed young material. A large proportion of the total herbage production is however grown over relatively short period and hence it is usually not practical for a grazer to control the maturity of feed offered to stock. This should indicate a need for species with a longer grown season and as lower rate of maturity even if total herbage yield is sacrificed and more intensive studies of grazing management to obtain better animal performance from standing hay. The only tropical grass which maintains a high digestibility with advancing maturity is sugarcane but animal production from animals grazing standing crops has not been good (Robert et al., 2003).

Voluntary intake declined with advancing maturity with tropical species. The same generally applies to temperate species. However some exceptions have been reported for temperature and tropical species of pasture. Pasture quality parameters decreased from the young to mature stage in summer autumn and winter. These differences may have arisen from either of two sources: selection behavior of animal may differ between levels of maturity or plant composition may differ between levels of maturity imported that the presence of an increased proportion of plant stems typical of older plant may restrict access to leaf parts and force animals to consume lower quality herbage. Sward greenness is positively correlated with the selection of a high quality diet. The quality of available bites is depressed when green leaf a material is scarce and largely dispersed among senescent material. These factors could explain the result of experiment especially in the case of the older autumn pasture for which NDF and ADL fractions increased (ORegain and Owen-smith., 1996) with level of maturity.

The nitrogen content of pasture also decreased from the young to mature stages in summer, autumn and winter, although difference were not statistically significant for all means. The NDF and ADL fractions differed between stages of maturity for all seasons the youngest and the oldest stages differed for all seasons except for ADF in autumn. The ADF concentration for autumn was lowest for the medium stage of maturity (Singh et al., 1995).

2.3. Intensity of Grazing

It is important to note that for most grasses and legumes forage yield increases as cutting frequency decreases while forage quality declines. The digestibility of both grasses and legumes decreases with maturity implying that forage should be fed at a younger stage for maximum energy digestibility. A wide range of digestibility occurs both between and within pasture species. One has to compromise between maximizing forage yield and quality and try to improve the latter by using better species for milk production.

In general defoliation affects the both above ground growth and under ground rooting system. In the case of legumes it affects also nodulation and nitrogenous activity when sufficient fertilizer and moisture are available a 6 to 10 weeks re growth interval should be the practice to obtain optimal yield and quality of forage except in the dry season when the cutting interval may inevitably be prologed (Cowan et al., 1997).

When pastures are grazed closely throughout the season, the total yield of DM is usually 30 to 50 percent less than when they are allowed to grow to the normal hay stage. This is due to the smaller leaf surface and lowered photosynthesis. Rotational and strip grazing or feeding green chop yields more nutrients per acre than does close continuous grazing over grazing reduces the yield of tall growing plants such as timothy, orchard grass, alfalfa and the erect clovers to a greater extent that of low growing spreading plants, such as blue grass, Bermuda grass and white clover. Animals allowed to graze selectively in an extensive grazing program pick and choose the leaves and finer part of stem which are more digestible and more nutritious, and reject the courser, steamy parts (Tyler and Ensminger, 2006).
2.4. Types of Soil

Soil PH is the first guide to mineral availability and the possibility of nodulation problems in legumes. Organic carbon and total nitrogen content and total nitrogen content of virgin soils also gives a general indication of the likely hood of fertility problems. The total content of other nutrients is every rough guide, and special extractants have been developed to indicate availability to plants comparing these tests with field pasture responses in a particular regions a much more reliable way of deciding which fertilizer is needed for instance the responses of tropical pasture to super phosphate with available soil phosphorus assessed by different methods. Soil type especially soil origin, and the vegetation association it bears, can be reliable guides to pasture establishment fertilizer needs. They are particularly useful as guides in pasture development operations with virgin land little altered by previous fertilizer application or agricultural use. The soil with poorly drained sites, a palm swamp indicates the most fertile soil, this is characterized by Licuala with calamas in the understudy. Less fertile soil a narrow leaf tee tree (Melaleuca) tall swamp forest develops whilst on the least fertile unit abroad leaf tea tree low layered swamp forest occur (Humphreys, 1978).

2.5. Fertilizer Application

The chief benefit from applying fertilizer to pasture is an increase in yield. In grass legumes pastures proper fertilizing can influence the proportion of legumes, in turn, this increases the protein, calcium, phosphorus and vitamin content of the mixture. Generally legume grass pastures with about 50 percent legumes do not require nitrogen (N) fertilization. However, it is important to maintain adequate level of lime, phosphorus (P), and potassium (K), in the soils of these pastures. Properly fertilized pasture plants begin growth earlier in the spring and continue growth later in the fall, thus extending the grazing season. The protein content of young immature non legume pasture is increased appreciably by nitrogenous fertilization unless there is already plenty of nitrogen in the soil (Tyler and Ensminger, 2006).

Pastures are usually grown to be eaten and the response to fertilizers must be assessed in terms of both growth and nutritive value. For some elements, animals needs are not related to plant needs. For instance; the content of sodium and of cobalt may limit animal performance but not affect pasture growth. In many situations fertilizer application will increase the content of minerals or of compounds of high biological value which increase animal out put. Single super phosphate contain P, S and calcium and it will be seen that fertilizer application increased the P and S content of legume and grass species to levels which were safe for animal production. The application of nitrogen fertilizer usually increases grass nitrogen content especially at high level of application (Humphrey, 1978).

In tropical regions where light and moisture are non limiting soil nutrients are the major factors affecting the production of forage. Due to highly weathered soil conditions, deficiencies of macro and micro nutrients in ultisol, oxisol, peat and marine sand were reported. Nutrient deficiencies may lead to the non persistence of the species, especially with legumes which are sensitive to molybdenum, copper, magnesium, boron and calcium. They may eventually affect animal production. There is are sponge of pasture growth and animal performance to the application of phosphorous fertilizer (Tham and Kerridge., 1982).

A high rate of nitrogen fertilizer is necessary to maintain high productivity of fodder grass. The dry matter yields of some of the improved and native species in response to nitrogen fertilizer are documented. Dry matter yield responses have been recorded up to as high as 1, 600 kg N/ha/year. Even though high rates of nitrogen increase dry matter yield the efficiency of use of nitrogen was found to decrease with increase rates of nitrogen applied. The nitrogen drops from 23.0 to 20.1 to 70.6 to 60.8kg Dm/kgN as nitrogen rates increases from 200 to 400 to 600 to 800 kg N/ha/year respectively. Where as at the same rate of application the nitrogen recoveries were 30.3, 38.4, 41.9 and 42.7%. Similar results on Napier and signal grasses were recorded at rates of 42.0, 34.2 and 25.2% nitrogen recovery as the nitrogen application rate increases from 200-400, 400-800 and 800-1600 kg/ha/yr. It implies that the most efficient nitrogen fertilizer rate should be around the level of 200-400 kg/N/yr. This further confirmed an earlier finding that nitrogen concentration in the forage had a limited effect on increasing the nutritional value and that nitrogen fertilizer at 250 kg N/ha/yr was sufficient for the attainment of crude protein for optimum digestion by the animal in the wet tropics (Mustapha et al., 1987).
2.6. Harvest and Storage Effects

The forage quality of hay and silage when fed is nearly always lower than that of the standing crops from which they were produced. Physical losses that disproportionately impacts the leaf component and respiration activity that utilizes non structural carbohydrates account for the quality reduction under good honest conditions. Greater level of shattering and respiration and leaching of soluble constituent cause much larger reduction in quality when rain damage occurs during harvest. Exposure to rain increased ADF and NDF and decreased DM digestibility of both alfalfa and red clover. With their higher proportion, of cell contents the quality of legume hay is reduced more by rain damage than is that of grasses. In one study more than 60% of the totals loss of DM, CP, ash, and digestible DM caused by rain on alfalfa hay come from the leaf component. Leaf loss, respiration and the likely hood that rain damage will occur are all reduced by harvesting forage as silage rather than hay. Forage quality can also be reduced when weathering, microbial activity, and undesirable chemical reactions occur during storage of hay or silage. Such quality losses can be very large for hay stored out side in high rain fall areas due to weathering (Robert et al., 2003).

Table 2. Composition of alfalfa and red clover hays

<table>
<thead>
<tr>
<th>Species and constituency</th>
<th>Well cured hay (%)</th>
<th>Rain damaged hay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP</td>
<td>26</td>
<td>25</td>
</tr>
<tr>
<td>NDF</td>
<td>32</td>
<td>45</td>
</tr>
<tr>
<td>ADF</td>
<td>28</td>
<td>39</td>
</tr>
<tr>
<td>DM digestibility</td>
<td>73</td>
<td>57</td>
</tr>
<tr>
<td>Red clover</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP</td>
<td>24</td>
<td>27</td>
</tr>
<tr>
<td>NDF</td>
<td>30</td>
<td>44</td>
</tr>
<tr>
<td>ADF</td>
<td>25</td>
<td>38</td>
</tr>
<tr>
<td>DM digestibility</td>
<td>68</td>
<td>47</td>
</tr>
</tbody>
</table>

Source: Collins (1983)

2.7 Environmental Effects and Diurnal Fluctuation

Forage grown under higher temperature condition is usually lower in quality that grown under cooler temperatures. One reason is that lignin deposition is increased by higher temperatures. Also, cooler growth temperatures lead to the accumulation of sugars and other non structural carbohydrates. Cool season grass forage reaches readily digestible non structural carbohydrates levels of more than 20% of DM under favorable growth conditions during fall. This temperature response is used to advantage in the stockpiling management system by applying N fertilizer and allowing grass forage to accumulate during fall (Robert et al., 2003).

2.8. Seasonal Effect

The need to measure animal performance in each season through out the year to fully understand nutritive value of pastures has recently been demonstrated by comparing seasonal variation in milk production form cows grazing three week old re growths of four setaria cultivars (Nadi kzungula, Narok and splendia) with pangola and kikuyu grass (pennisetum clandestinum). The ranking order varied markedly between seasons. Highest animal production which occurs early in the growing season can partly be explained by higher digestibility of early formed tillers. There a relate depressions in milk production to periods of growth when pangola produced inflorescence planting non flowering varieties, provided that they persist or planting species with different flowering habits could possibly allow increased production from high producing stock (Stobbs, 1973c).

There are marked seasonal effects up on leaf /stem rations, nitrogen and dry matter content of pangola which could explain seasonal variation in production since leaf is eaten in much larger
quantities than stem of a similar digestibility. Despite the growth of young nutritious herbage at the commencement of the rains this is usually a period of weight loss or poor growth (Walker, 1969).

2.9. Toxic Factor

Some toxins and undesirable compounds influence potential productivity and also quality of the saleable meat and milk. Tropical pastures are relatively free of such anti quality components. Fortunately animals grazing tropical legumes are almost entirely free of bloat, this may be associated with the relatively high tannin content which is high relative to temperate legumes such as medicago sativa. levels of testrogenic substances in tropical legumes do not cause concern (Hutton., 1971).

3. SUMMARY AND CONCLUSION

The nutritive value of pastures is the determinant factor which determine animals performance productive and reproductive. The nutritive value or pasture quality mainly determined by many factors those affect the plant digestibility. The type of soil, level of fertilizer application, plant specials, stage of maturity of plant, intensity of grazing, harvest and storage conditions, Season, toxic factor plants contain, climatic condition affect the pasture value or quality. The poor nutrient of the soil affect the pasture by the deficiency of minerals or nutrients.

As the stage of plant very mature the nutritive value of pasture decline. Increased pasture maturity had a negative effect on the nutritional value of pasture, indicating that this forage best utilized at younger stages of development. The primary factor which affect nutritive value of pastures are forage species, maturity stage and harvesting conditions. Secondary influences include climatic condition, soil and fertility of soil. So to improve the nutritive value or quality of pasture the over all above factors should be managed under good condition at which the pasture growth quality, digestibility, were obtained though through managing the pasture it is possible to improve the animal production and productivity.

4. PROSPECTS

The pasture quality (nutritional value) improved by applying good management, the botanical composition (species of grass and legumes) in a pasture and harvesting and utilizing at young stage is the most important management practice to obtain the best nutritional value of pasture and to improve the production of the livestock. Having good knowledge of pasture management and awareness of pasture is important to have good quality pasture by eliminating factors affecting them and interns improve our livestock production and productivity.

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