Supplementation of ruminants on winter pastures

20/03/2016

Enhancing poor quality roughage utilization through supplementation and subsequent improvement in extensive ruminant production in South Africa

Research Focus Area: Livestock Production with Global Competitiveness

Year of completion: 2016

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EXECUTIVE SUMMARY

A series of studies was conducted to evaluate differential energy and nitrogen (N) sources as supplemental feed to sheep grazing low quality winter grazing in the High veldt. Knowledge on supplementation under local conditions are limiting as the majority of supplementation studies are funded and performed in the more temperate areas. Results indicated that higher N and energy inclusion levels are necessary to optimize ruminant production under local conditions compared to temperate areas. In addition, the ratio of fermentable energy to available protein is an important parameter in optimizing supplementation programs. It is concluded that the supplementary recommendations from the current feeding tables does not describe the requirements and nutrient quality of the tropical grasses satisfactorily and as such, cannot be used to predict supplementation responses by the tropical forage fed ruminant.

Project Aims

1. To develop a cost-effective supplementation strategy for ruminants under low quality winter forage conditions.
2. To maintain body weight during the winter season by assessing different sources and levels of nutrients that enhances poor quality roughage utilization.
3. To investigate intake, fiber degradation and microbial protein production when various types and levels of nutrients are supplemented to ruminants kept at maintenance under extensive conditions.

Popular Article

Title for Popular Article

SUPPLEMENTATION OF SHEEP GRAZING LOW QUALITY GRASSES WITH UREA AND STARCH

INTRODUCTION

Every year sheep might lose up to 30% of their summer body weight gain during the dry winter periods in the high veldt. While these weight losses have an economic impact on its own, it also is associated with an increased susceptibility for diseases and parasitic infestations and decreased reproductive performances. It generally is considered that protein or non-protein nitrogen (NPN) supplementation is necessary to limit these weight losses during these periods. However, due to the type of grass found in the High veldt area of Southern Africa, data is limiting on the effects of supplementation of ruminants grazing these types of grasses (See box: Differences between C4 and C3 grasses). As such, supplementations recommendations derived from current feeding tables seldom satisfy the needs of the grazing ruminant in Southern Africa. Therefore, a series of studies was conducted at the University of Pretoria to determine and quantify the requirements of the ruminant grazing low quality Eragrostis curvula hay commonly found in the Southern Africa High veldt.

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Box 1: Differences between C4 and C3 Grasses

The acronyms C3 and C4 refer to the first product of the photosynthetic processes in the respective grasses with the first product of photosynthesis in the C3 grass being phosphoglycerate (a 3-carbon structure) while for the C4 plant, the corresponding molecule is a 4-carbon molecule (oxaloacetate). C3 grasses are temperate grasses and are adapted to the temperate regions of the world where rainfall is more constant with maximum temperatures seldom topping 22 OC. In contrast, C4 grasses are more adapted to the subtropical and tropical climates with temperatures frequently topping 25oC during the growth period. These areas also are associated with seasonal droughts and the occasional frost. Due to these extremes in temperatures and seasonal droughts, C4 grasses contain more bundle sheath cells and less available nutrients compared to C3 grasses during all maturity stages. Ruminant production therefore in general is significantly lower in ruminants grazing C4 grasses compared to temperate C3 grasses, especially during the dormant stage of the grass where lignification of the C4 grasses reduces the availability of the nutrients even further. As such, supplementation requirements and responses differ between ruminants grazing these grasses. However, the majority of supplementation studies in the past have been conducted on C3 grasses as it is found more in the European countries where research funding is more available. As such, as more studies conducted on low quality C3 grasses are incorporated in the current feeding tables, supplementation requirements derived from these tables to the low-quality tropical forage fed ruminant are not always accurate. As such, the need was established to conduct research through the financial support of the **RMRD-SA on the nutritional requirements of the low-quality tropical forage fed ruminant in order to improve ruminant production in Southern Africa.

**RMRD -SA – Red Meat and Research Development, South Africa

Results and Discussion

The quality of hay (Eragrostis curvula) used as the basal diet in the study was extremely poor with a crude protein (CP) analysis of 2.7%. In addition, the NDF fraction (neutral detergent fibre) of the hay was more than 75%. As such, the quality of the hay used would not have met the maintenance requirements of the wethers, a situation often experienced in the High Veldt during the dry winter months where ruminants loose body weight and condition.

Four cannulated wethers received this hay ad lib and were supplemented one of 12 treatments (4 urea and 3 starch levels combined in a factorial method, creating the 12 treatments). The supplements were placed directly into the rumen (twice daily at 08h00 and 16h00) via rumen cannula. The 4 urea levels used in the supplements were 10.4 g (LU treatment); 18.4 g (MU); 26.4g (HU) and 32.4 g (EHU) urea per wether per day where LU, MU, HU and EHU are acronyms symbolising low urea, medium urea, high urea and extra high urea respectively. The 3 pure corn starch levels used in the supplements were 200 g (LS), 240 g (MS) and 280 g starch per wether per day (HS) with LS, MS and HS representing low starch, medium starch and high starch respectively.

The data was analysed as 3 blocks (starch) with each block consisting of a 4 x 4 Latin square (4 urea treatments with 4 animals per treatment). As such, each of the 12 treatments were repeated 4 times (4 wethers) for a total of 48 experimental data units.

Forage intake and digestibility was not influenced by either the level of urea or starch supplementation to the wethers. However, CP-balance, measured as CP intake – CP excretion in the faeces and urine, increased from 12.5 g CP/day in the LU wethers up to 70 g CP/day in the EHU wethers. Based on these observations, only the EHU treatment supplied sufficient protein to potentially satisfy the needs of the 50 kg wethers as they require 65 – 70 g CP for maintenance. These recommendations are significantly higher than the recommendations set in the current feeding standards, however, it is in alignment with the observations and recommendations set out by **Leng (1995) studying ruminants grazing tropical grasses in Australia.

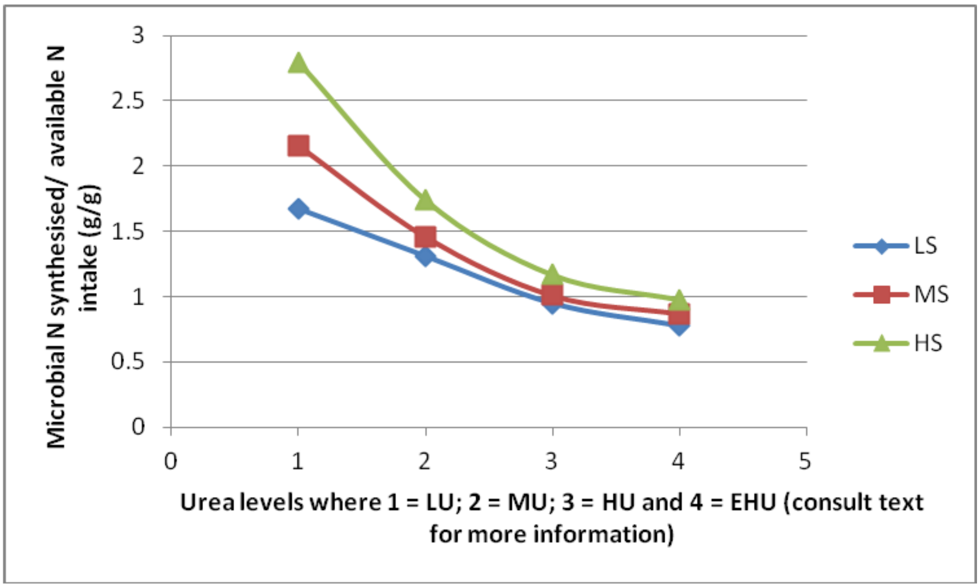
HIGHER LEVELS OF PROTEIN AND ENERGY SUPPLEMENTATION IS NECCESARY TO OPTIMISE THE GRAZING RUMINANT IN THE S.A. HIGH VELDT DURING THE DRY WINTER MONTHS

An important parameter in ruminant nutrition is microbial protein synthesis (MPS) as it gives an indication of the efficiency of the rumen microbes. During the dry winter months, MPS generally decreases due to the lack of available nutrients in the roughages (Leng, 1990, 1995) which decreases the productivity of the animal which is experienced as weight loss by the farmer. In this study, MPS increased almost 50% from 78 g MPS to 106 g MPS as the level of starch supplemented was increased from 200 (LS) to 280 (HS) g starch/day. This observation is in agreement with suggestions made by Leng, (1990; 1995) that energy is an important nutrient driving MPS in the tropical forage fed ruminant, provided that the protein requirements of the ruminant have been met. Interestingly, energy supplementation for the temperate forage fed ruminant is not always advocated as these grasses contain higher concentrations of water soluble carbohydrates compared to the tropical grass.

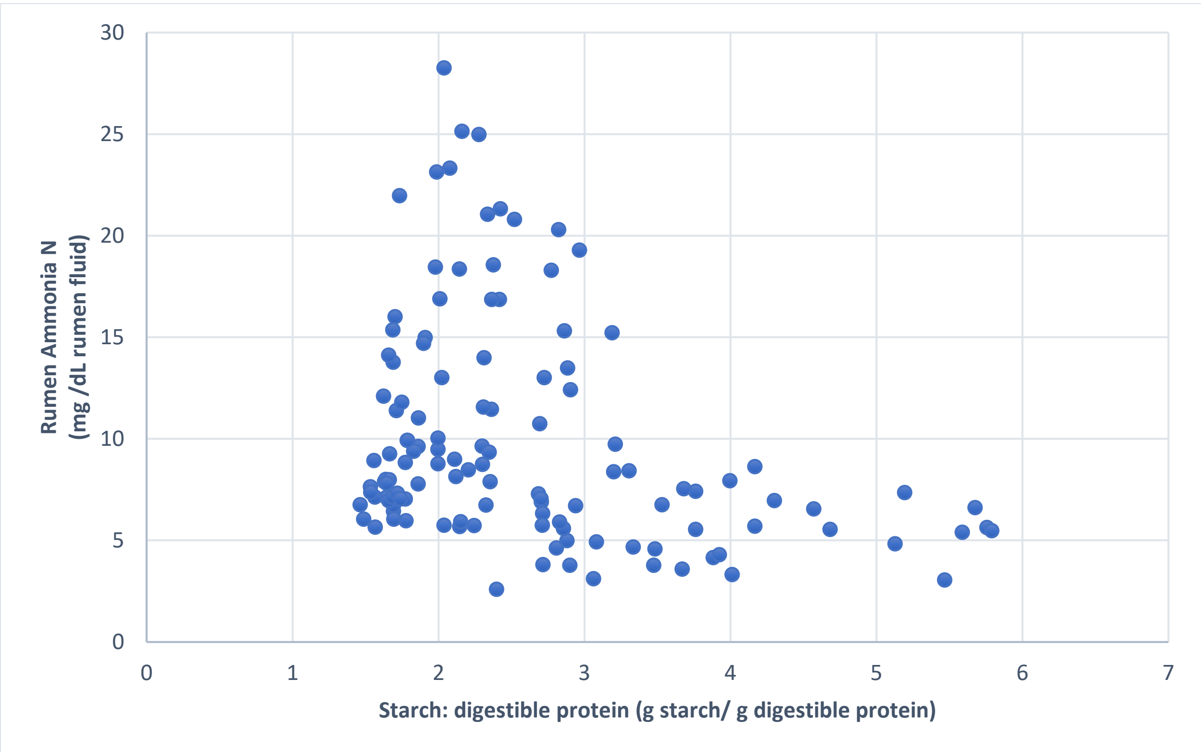
Based on the above results, higher levels of both protein and energy supplementation is necessary to optimise ruminant production during the dry winter months in the High Veldt. The question now was asked whether there was an "ideal" quantity of protein and energy to be supplemented to ruminants grazing low quality "tropical" forages.

Graph 1 is a schematic representation of MPS per unit CP intake (MNS: N intake) while Graph 2 represents the mean rumen ammonia nitrogen (RAN) concentration as influenced by the ratio of starch supplemented to available protein intake.

Graph 1: Microbial CP synthesised (g) per unit available CP intake (g) as influenced by the level of urea supplemented within each starch level.



Urea supplementation across all three starch treatments affected the MPS: CP ratio similarly with the ratio decreasing from almost 3 to below 1 where the wethers were supplemented with the higher urea treatments (HU and EHU). It is important to note that alleviated MPS: CP levels (above 1) could be indicative of CP deficiency as more microbial protein was synthesized in the rumen compared to dietary CP intake. The additional CP required to produce the microbial protein under these circumstances is derived from body protein catabolism which in itself, is an inefficient process, resulting in an excessive body weight loss. As such, in this trial, it is suggested that the protein intake of the wethers supplemented with at least 26.4 g urea/day (HU) was sufficient to meet the requirements of the wethers.



Graph 2: Mean rumen ammonia nitrogen concentration as influenced by the ratio of starch supplemented and digestible protein intake

An inverse relationship was observed between RAN and the ratio of starch: digestible protein intake (Graph 2) with RAN decreasing and plateau between 5 and 10 mg RAN/ dL rumen fluid as the ratio increased. An inflexion point was observed where RAN increased exponentially to levels as high as 25 and even 30 mg RAN/dL rumen fluid as the ratio decreased below 2: 1. This graph highlights the importance of supplementation of both rumen available energy sources (starch in this instance) as the supplementation of only RDP sources to the ruminant could lead to an increased risk of ammonia toxicity under these circumstances.

Conclusion

The results from this study suggest that the supplementation requirements of 50 kg wethers grazing low quality tropical forages (2.7% CP) differs to the current feeding standards as:

- Higher levels of protein (urea supplementation up to 26.4 g urea per day per wether or 3% urea of the total DM intake) is necessary to optimise CP balance in the tropical forage ruminant.
- Starch supplementation (up to 280 g/wether/day or almost 20% of the total DM intake) in addition to urea supplementation is necessary as tropical grasses not only are deficient in protein, but also in easy available energy.
- For wethers grazing low quality tropical grasses, the ideal ratio of starch supplemented to digestible protein intake lies between 2 and 3: 1.
- Additional research is necessary to study the effects of other energy sources and protein sources on rumen environment and the production parameters of the tropical forage fed ruminant as these sources might have different availabilities compared to urea and pure starch within the rumen.

The authors wish to thank the Red Meat Industry and Research Development (RMRD) for their financial support of this study.

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