

ABSTRACT

EVALUATION OF THE INCLUSION OF A COMMERCIAL SLOW-RELEASE UREA-MOLASSES PRODUCT (UREIDE) IN LICKS FOR SHEEP FED LOW-QUALITY ROUGHAGE

by

HEINRICH MARTIN BÖHME

Supervisor:	C.W. Cruywagen, (D.Sc.Agric.)
Co-supervisor:	J. Coetzee, Ph.D. (Agric.)
Department:	Animal Sciences
Faculty:	Agricultural Sciences
University:	Stellenbosch
Degree:	M.Sc.Agric.

An experiment was conducted to study the potential of a liquid slow-release urea-molasses product (Bonded Urea Plus®) for the inclusion in licks for ruminants. Six ruminal fistulated Merino wethers received low-quality wheat straw (< 3 % crude protein) *ad lib.* during Phase I. Each sheep received 6 different licks over six 11-day treatment periods in a crossover design, which contained different sources of carbohydrates together with urea/molasses or Bonded Urea Plus® (BUP). Licks U & BU served as controls and did not contain any carbohydrates, while Licks UME & BUME included molasses meal (sugar source) and Licks UMI & BUMI maize meal and starch (starch source) in addition to either urea/molasses or BUP. The different sources of urea and carbohydrates had no influence ($P > 0.05$) on the ruminal $\text{NH}_3\text{-N}$ -concentrations, ruminal pH and blood urea-N-concentrations of the 6 sheep on different time intervals after feeding of the respective licks. No differences ($P > 0.05$) were furthermore found between treatments with respect to N utilization and DM digestion. The digestibility of the wheat straw was estimated after completion of a *in sacco* digestibility trial using the model $p = a + b(1 - e^{-ct})$, but no differences were found between treatments ($P > 0.05$). The effective degradability of the wheat straw was calculated at fractional outflow rates of 0.02/h and 0.05/h and averaged 50.42 and 36.18 %, respectively. The average microbial N outflow (13.06 g/kg VOM_i) was calculated from the allantoin content of the urine and didn't differ ($P > 0.05$) between the different treatments during Phase I, possibly

due to the similar $\text{NH}_3\text{-N}$ -concentrations of the treatments. It was concluded that the ruminal N-release and its consequential utilization by the rumen microorganisms did not differ between urea/molasses and BUP, and that factors like the carbohydrate source used, as well as management, had a greater influence on first mentioned than the source of the urea supplement. Furthermore, because no differences were found between the time intervals when rumen $\text{NH}_3\text{-N}$ -concentrations reached a maximum in the sheep after feeding the different supplements. It is doubtful if BUP may be classified as a slow-release urea-molasses product, and if the product does in fact contain ureides.

The observation during Phase I that BUP tended to release lower levels of $\text{NH}_3\text{-N}$ in the rumen of the sheep led to the investigation of BUP's potential as a less toxic NPN/energy-supplement as urea/molasses. Fifteen ruminal fistulated Merino wethers were divided into 3 groups at random and received wheat straw *ad lib*. Each group of sheep received the same maintenance lick during Phase II. In addition, the 3 groups of sheep were administered different levels of BUP, namely 67, 100.5 and 134 g/s/d (equivalent to 15, 22.5 and 30 g urea/s/d), directly into the rumen over three 1-day treatment periods in a crossover design. No symptoms of urea toxicity were detected, which suggests that less $\text{NH}_3\text{-N}$ was released from BUP than from urea/molasses. The average maximum rumen $\text{NH}_3\text{-N}$ and blood urea-N-concentrations of the sheep after administration of Treatments A (15 g urea/s/d), B (22.5 g urea/s/d) and C (30 g urea/s/d) differed significantly ($P < 0.01$), and were the highest in Treatment C. A 7-day digestibility and balance study was conducted with the 15 sheep at the end of Phase II. The DM-, ADF- and NDF-digestibility in the sheep differed between treatments ($P < 0.01$), and Treatment C resulted in the best digestibility. Although Treatment A resulted in a negative N-balance, the sheep receiving treatment A had the best N-utilization. It can be concluded that N is released too quickly from BUP to be efficiently utilized by the rumen microbes during high feeding levels.

The results of Phases I and II left many questions unanswered and it was decided to analyse BUP for ureides and/or free urea in the laboratory using electrospray mass spectrometry. The results show that urea is present in BUP mainly in the unbound form and that most probably no ureides have formed during the manufacturing process. Due to these results and the

absence of high N-contents in the faeces of the sheep during Phase II, it can be speculated that part of the urea-N in BUP has bound to other compounds in the molasses. It seems as if these compounds release the N in the lower intestines where it is absorbed and mainly excreted in the urine without being available for microbial utilization.

Supplementation of lower equivalent levels of urea in the form of urea/molasses compared to higher levels of BUP will probably result in similar production of ruminants. Urea/molasses will be more economical and BUP can thus not be recommended as a substitute for urea/molasses as a NPN/energy source in licks for ruminants on low-quality pastures in South Africa.

SAMEVATTING

EVALUERING VAN DIE INSLUITING VAN 'N KOMMERSIËLE STADIG VRYSTELLENDSE UREUM-MELASSEPRODUK (UREÏED) IN LEKKE VIR SKAPE OP LAEGRAADSE RUVOER

deur

HEINRICH MARTIN BÖHME

Studieleier:	C.W. Cruywagen, (D.Sc.Agric.)
Mede-studieleier:	J. Coetzee, Ph.D. (Agric.)
Departement:	Veekundige Wetenskappe
Fakulteit:	Landbouwetenskappe
Universiteit:	Stellenbosch
Graad:	M.Sc.Agric.

Die potensiaal van 'n vloeibare stadig vrystellende ureum/melasse produk (Bonded Urea Plus®) vir die insluiting in herkouerlekke is ondersoek. In Fase I is 6 rumengefistuleerde Merino hamels laegraadse koringstrooi (< 3 % ruproteïen) *ad lib.* gevoer. Die skape het ses verskillende lekke in 'n oorskakelproefontwerp oor ses 11-dae behandelingsperiodes een na die ander ontvang wat verskillende koolhidraatbronne saam met ureum/melasse of Bonded Urea Plus® (BUP) bevat het. Lekke U & BU het as kontroles gedien en geen addisionele koolhidraatbron bevat nie terwyl melassemeel (suikerbron) in Lekke UME & BUME en meliëmeel en -stysel (styselbron) in Lekke UMI & BUMI addisioneel tot ureum/melasse of BUP ingesluit is. Die verskillende ureum- en koolhidraatbronne het geen invloed ($P > 0.05$) op die rumen-NH₃-N-konsentrasies, rumen-pH en bloedureum-N-konsentrasies van die 6 skape by verskillende tye na voeding van die onderskeie lekke gehad nie. Geen verskille is verder tussen die behandelings gevind in 'n N-balans- en verteringsstudie nie ($P > 0.05$). Die degradeerbaarheid van die koringstrooi is na 'n *in sacco*-verteringsproef met behulp van die model $p = a + b(1 - e^{-at})$ vir die verskillende behandelings bereken maar geen verskille ($P > 0.05$) is gevind nie. Die effektiewe degradering van die koringstrooi is by uitvloeitempos van 0.02/h en 0.05/h bereken en was gemiddeld 50.42 en 36.18 % onderskeidelik. Die gemiddelde mikrobiële N-uitvloeï (13.06 g/kg VOM_i) is vanaf die allantoïëeninhoud in die urine bereken en het nie tussen die verskillende lekke gedurende Fase I varieer nie ($P > 0.05$).

Die gevolgtrekking is gemaak dat die ruminale N-vrystelling en die gevolglike benutting daarvan deur die rumenmikrobes nie tussen ureum/melasse of BUP verskil het nie, en dat dit eerder beïnvloed is deur faktore soos die aard van die addisionele koolhidraat gevoer, asook bestuur (frekwensie van voeding, hoeveelheid lekkie gevoer, smaaklikheid, ens.), as deur die aard van die ureumsupplement. Aangesien die tye van maksimum rumen-NH₃-N-konsentrasie na voeding van die verskillende lekkie ook nie verskil het nie, kan dit bevraagteken word of BUP as 'n stadig vrystellende ureum/melasse produk geklassifiseer mag word en of die produk ureiede bevat.

Die waarneming dat BUP geneig is om laer NH₃-N-konsentrasies in die rumen te veroorsaak is in Fase II ondersoek deur die potensiaal van BUP as 'n minder toksiese NPN-aanvulling as ureum/melasse te bepaal. Vyftien rumengefistuleerde Merino hamels is ewekansig in 3 groepe ingedeel en het koringstrooi *ad lib.* ontvang. Elke groep skape is dieselfde tipe mineraal-energielek gedurende Fase II gevoer. Bykomend het hulle verskillende peile van BUP, naamlik 67, 100.5 en 134 g/s/d (ekwivalent aan 15, 22.5 en 30 g ureum/s/d, respektiewelik), direk deur die rumenfistel oor drie 1-dag behandelingsperiodes in 'n oorskakelproefontwerp ontvang. Geen tekens van ureumvergiftiging is waargeneem nie wat op 'n laer NH₃-N-vrystelling vanaf BUP as vanaf ureum/melasse dui. Die gemiddelde maksimum rumen-NH₃-N- en bloedureum-N-konsentrasies van die skape wat na toediening van Behandeling A (15 g ureum/s/d), B (22.5 g ureum/s/d) en C (30 g ureum/s/d) bereik is, het van mekaar verskil ($P < 0.01$) en was die hoogste by Behandeling C. Aan die einde van Fase II is nog 'n 7-dae verterings- en balansstudie met die 15 skape deurgevoer. Die verteerbaarheid van DM, ADF en NDF in die skape het tussen die behandelings verskil ($P < 0.01$). Behandeling C het die beste verteerbaarheid gehad. Alhoewel die skape wat Behandeling A ontvang het in 'n negatiewe N-balans verkeer het, het hulle die beste N-benutting gehad waarskynlik weens verhoogde ureumhersirkulering na die rumen. Hieruit kan afgelei word dat die N te vinnig vanaf BUP vrygestel word om doeltreffend teen hoë voedingspeile deur die rumenmikrobes benut te word.

Die resultate van Fases I en II het baie vrae onbeantwoord gelaat en daar is besluit om BUP in die laboratorium met behulp van elektrospoei-massaspektrometrie te ontleed vir ureiede

en/of suiwer ureum. Die resultate het getoon dat ureum hoofsaaklik in die ongebonde vorm in BUP voorkom en dat waarskynlik geen ureïede gedurende die vervaardigingsproses gevorm het nie. Aan hand van laasgenoemde resultate tesame met die afwesigheid van hoë mis-N-waardes gedurende die balansstudie van Fase II kan gespekuleer word dat 'n gedeelte van die ureum-N in BUP aan verskeie ander komponente in melasse gebind het. Hierdie verbindings los nie in die rumen op nie wat aanleiding gee tot die laer rumen-NH₃-N-konsentrasies. Moontlik stel hulle egter die N laer af in die spysverteringskanaal vry waar dit geabsorbeer word en hoofsaaklik onbenut in die urine uitgeskei word.

Aanvulling van laer ekwivalente ureumpeile in die vorm van ureum/melasse sal waarskynlik in dieselfde produksie van herkouers as hoër peile BUP resulteer. Eersgenoemde sal meer ekonomies wees en kan BUP dus nie as 'n plaasvervanger van ureum/melasse as NPN/energiebron in lekke vir herkouers op laegraadse weidings in Suid-Afrika aanbeveel word nie.
