

*RUMINAL DEGRADATION OF PROTEIN OF
VARIOUS FEEDSTUFFS AND ITS AFFECT ON POST-
RUMINAL
AMINO ACID FLOW IN HIGH-PRODUCING DAIRY COWS*

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ABSTRACT

RUMINAL DEGRADATION OF PROTEIN OF VARIOUS FEEDSTUFFS AND ITS AFFECT ON
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Several new protein evaluation systems for dairy cattle have been published during the last decade, all having in common increased efficiency of protein utilization by dairy cows. Because of presumed limitations of ruminal fermentation capacity and microbial growth, dietary protein for high-producing dairy cows can best be supplied by a known quantity of rumen degradable (RDP) and rumen undegradable protein (UDP). Therefore RDP and UDP are included in feeding standards. Since protein sources vary in the amount that escapes rumen fermentation, it is important to quantify the post-ruminal contribution of various feedstuffs.

To enable Southern African dairy producers to apply international feeding standards, a protein degradability data base, covering the local feedstuffs normally used in dairy cattle diets, was established using the *in situ* polyester bag technique. The data base includes 20 protein sources, 11 energy sources and 13 roughages.

Many studies utilizing the RDP-UDP concept have given inconsistent results and probable reasons for this are that some UDP may be indigestible or the UDP source is of poor quality (AA profile). In the present study, various feedstuffs were evaluated in terms of UDP- and intestinal absorbable AA profiles, as well as UDP digestibility, using the *in situ* polyester- and mobile bag techniques. Results suggest that the constant factor for UDP digestibility that is currently used by many protein systems is not warranted and should be reconsidered. Results also suggest that rumen degradation has a greater influence than post-ruminal digestion on the post-ruminal provision of specific absorbable AA.

Because of the significant equalizing effect of rumen fermentation on the duodenal AA profile, a study was conducted to investigate the effect of supplemental UDP source on post-ruminal provision of AA. The source of supplemental protein was found to be closely reflected in the duodenal AA profile and significantly influenced the post-ruminal AA flow. The results suggest that altering the AA profile via protein source selection is feasible, but the following criteria must be satisfied: 1) microbial protein synthesis must be maintained by including urea or a highly degradable source; 2) supplementary protein must have an AA profile complementary to microbial protein; 3) complementary proteins must be resistant to rumen degradation, yet available in the SI; 4) since most protein sources are a poor source of at least one essential AA, feeding combinations of complementary protein sources may be the best practical approach to supply limiting AA; 5) supplementary low degradable protein sources should contribute at least one third of total CP.

Finally, total dietary protein degradability and UDP digestibility were determined *in vivo* and with the mobile bag respectively, and compared with calculated values from individual feed values that were obtained from data bases. The compared values agreed favourably and should give potential users confidence in including these data bases in dairy formulation programs.

SAMEVATTING

RUMEN-PROTEÏENDEGRADEERBAARHEID VAN VERSKEIE VOERBRONNE EN DIE INVLOED
DAARVAN OP POST-RUMINALE AMINOSUURVLOEI BY HOOGPRODUSERENDE MELKKOEIE
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Verskeie nuwe proteïenevalueringstelsels vir melkkoeie is die afgelope dekade gepubliseer. Hierdie stelsels het almal in gemeen die verhoogde doeltreffendheid van proteïenbenutting deur melkkoeie. Vanweë beperkings op die kapasiteit van die koei om mikrobiese proteïen te vervaardig, word 'n sekere hoeveelheid nie-degradeerbare proteïen ook benodig en gevolglik word die proteïenbehoefte van melkkoeie in voedingstandaarde aangegee in terme van rumen degradeerbare (RDP) en nie-degradeerbare proteïen (UDP). Aangesien proteïenbronne verskil in proteïendegradearbaarheid is dit belangrik om hierdie bronne te kwantifiseer in terme van post-ruminale proteïenvoorsiening.

Ten einde Suider-Afrikaanse melkprodusente in staat te stel om internasionale voedingstandaarde te gebruik, is 'n proteïendegradearbaarheidsdatabank saamgestel deur gebruik te maak van die *in situ* poliëster sak tegniek. Die databank sluit in 20 proteïenbronne, 11 energiebronne en 13 ruvoere.

Verskeie studies waarin die RDP-UDP konsep toegepas is, het wisselvallige produksieresultate gelever. Moontlike redes hiervoor is dat sommige UDP bronne swak verteerbaar mag wees of dat die UDP-bron van 'n swak kwaliteit (aminozuurprofiel) kan wees. In hierdie studie is verskeie voerbronne geëvalueer in terme van UDP- en intestinaal absorbeerbare aminozuurprofiel en UDP-verteerbaarheid, deur gebruik te maak van die *in situ* poliëster sak- en mobiele sakkie tegnieke. Die resultate dui daarop dat die konstante faktor vir UDP-verteerbaarheid wat tans deur die meeste proteïenstelsels aanvaar

word, heroorweeg moet word. Resultate het ook aangedui dat rumendegradering 'n groter effek op die post-ruminale voorsiening van spesifieke absorbeerbare aminosure gehad het as post-ruminale vertering.

Vanweë die betekenisvolle gelykstellende effek van rumenfermentasie en die gepaardgaande mikrobiëse proteïenproduksie op die duodenale aminosuurprofiel, is 'n studie uitgevoer om ondersoek in te stel na die effek van gesupplementeerde proteïenbron op die post-ruminale voorsiening van aminosure. Resultate het aangedui dat verskille in aminosuurprofiel van die gesupplementeerde proteïenbronne duidelik gereflekteer word in die duodenale aminosuurprofiel en duodenale vloei van aminosure. Die resultate dui verder daarop dat manipulasie van die duodenale aminosuurprofiel wel moontlik is deur sinvolle seleksie van proteïenbronne, maar daar moet voldoen word aan die volgende voorvereistes: 1) mikrobiëse proteïenproduksie moet gehandhaaf word deur insluiting van ureum of hoog degradeerbare proteïenbronne; 2) gesupplementeerde proteïenbronne moet die aminosuurprofiel van mikrobiëse proteïen kompleet en nie dupliseer nie; 3) gesupplementeerde proteïenbronne moet laag degradeerbaar wees maar ook beskikbaar wees vir absorpsie in die dunderm; 4) aangesien meeste proteïenbronne swak voorsiener is van ten minste een essensiële aminosuur, behoort die mees praktiese aanbeveling te wees om kombinasies van kompleterende proteïenbronne te supplementeer; 5) gesupplementeerde laag degradeerbare proteïenbronne behoort ten minste een derde tot die totale dieetproteïen by te dra.

Laastens is die totale dieet-proteïendegradeerbaarheid en UDP-verteerbaarheid bepaal *in vivo* en met die mobiele sakkie tegniek, respektiewelik. Hierdie waardes is vergelyk met berekende waardes vir hierdie diëte waar gebruik gemaak is van waardes van individuele dieetkomponente wat verkry is uit databanke. Daar was goeie ooreenstemming tussen die vergelykbare waardes en dit behoort potensiële gebruikers die nodige vertroue te gee om die databanke in te sluit in dieet-formuleringsprogramme.