

**AVAILABILITY AND PARTITIONING OF AMINO
ACIDS FROM VARIOUS
HEAT PROCESSED PROTEIN SOURCES
TO THE MAMMARY GLAND OF LACTATING
DAIRY COWS**

by

GUIDO ERNST SCHROEDER

Submitted to the Faculty of Agriculture
(Department of Animal and Wildlife Sciences),
University of Pretoria, in partial fulfilment of
the requirements for the degree *Philosophiae Doctor*

PRETORIA

January, 1998

ABSTRACT**AVAILABILITY AND PARTITIONING OF AMINO ACIDS
FROM VARIOUS HEAT PROCESSED
PROTEIN SOURCES TO THE MAMMARY GLAND OF
LACTATING DAIRY COWS**

by

GUIDO ERNST SCHROEDER

Supervisor : Prof N H Casey
Co-supervisor : Dr H H Meissner
Department : Animal and Wildlife Sciences
Degree : Ph D

Due to the high degradability of some of the oilcakes used in South African dairy cattle diets, inclusion levels are limited and one method to increase inclusion levels is to heat process the oilcake. There is little information and thorough investigation into the effect of heat processing of plant and animal protein sources available in terms of effective ruminal protein degradability, undegradable protein digestibility, absorbable amino acid (AA) profile including the "optimum" processing regime, microbial protein synthesis and the partitioning of the AA to the mammary gland for milk synthesis is necessary.

The usefulness of acid detergent insoluble nitrogen was accentuated as a screening test for

heat processed plant protein sources and an equation was successfully established to predict the digestibility of rumen undegradable protein of both unprocessed and heat processed plant protein sources. An "optimum" heat processing baseline of two animal and seven plant protein sources for inclusion in dairy cattle diets was furthermore established. With whole oilseeds, heat processing increased oleic acid with positive future implications, such as a softer butter when these are fed to dairy cows.

Roasting decreased volatile fatty acids concentrations, ammonia-N and microbial crude protein synthesis, but increased the non-ammonia nitrogen flow. Microbial synthesis was overestimated when purine derivatives in the urine were used to determine microbial protein synthesis. The essential AA profile of the duodenal digesta demonstrated a decrease in lysine, methionine and valine when roasted or burnt sunflower oilcake is fed, accentuating that these AA are still to be considered as the primary limiting factors in dairy cattle diets. In a follow-up study, using the same diets, the same tendencies in milk production, composition and dry matter intake were obtained. Uptake of AA by the mammary gland, as measured by the arterio-venous difference technique, was numerically reduced for cows fed roasted or burnt sunflower oilcake compared to the control animals. This was in contrast to published results but possible reasons were limited energy supply, stage of lactation and high inclusion level, or the possibility exists that the AA may not have been available. Future trials should include lactation studies to address this matter.

Key words: dairy cows, protein, amino acids, heat, processing, degradability, availability, partitioning

SAMEVATTING

BESKIKBAARHEID EN VERDELING VAN AMINOSURE VAN VERSKEIE HITTEGEPROSESSEERDE PROTEÏENBRONNE NA DIE MELKKLIER VAN LAKTERENDE MELKKOEIE

deur

GUIDO ERNST SCHROEDER

Promotor : Prof N H Casey
Mede-promotor : Dr H H Meissner
Departement : Vee- en Wildkunde
Graad : Ph D

As gevolg van die hoë degradeerbaarheid van sommige oliekoeke wat in Suid-Afrikaanse melkbeesdiëte gebruik word, is insluitingspeile beperk en 'n manier om die insluitingspeile te verhoog, is deur hitteprosessering. 'n Leemte bestaan egter ten opsigte van inligting oor die effek van hitteprosessering van plant- en dierlike proteïenbronne wat in Suid-Afrika beskikbaar is, in terme van effektiewe rumen proteïen degradeerbaarheid, ondegradeerbare proteïen verteerbaarheid, absorbeerbare aminosuur (AS) profiel, insluitend die "optimum" prosesseringsregime, mikrobe proteïensintese en uiteindelik die verdeling van die AS na die melkklier van die melkkoei vir melksintese, en is tot dusver nog nie deeglik ondersoek nie.

In hierdie studie is die bruikbaarheid van suur bestaande onoplosbare stikstof beklemtoon as 'n siftingstoets vir hitte geprosesseerde proteïenbronne en 'n vergelyking is suksesvol bevestig om die verteerbaarheid van rumen ondegradeerbare proteïen van beide ongeprosesseerde en hitte geprosesseerde plant proteïenbronne te voorspel. 'n "Optimum" hitte-prosessering basislyn van sewe plant- en twee dierlike proteïenbronne vir insluiting in melkkoeidiëte, is verder vasgestel. In die geval van heel oliesade het hitte prosessering oleïensuur verhoog met positiewe toekomstige implikasies, soos byvoorbeeld 'n sagter botter wanneer hierdie aan melkkoeie gevoer sou word.

Geroosterde sonneblomoliekoek het vrye vetsuur konsentrasies, ammoniak-N en mikrobiële proteïen sintese verlaag, maar nie-ammoniakstikstof (NAN) vloei verhoog. Die gebruik van purienderivate in uriene om mikrobiële proteïensintese vas te stel, het mikrobiële sintese oorberaam. Die essensiële AS profiel van die duodenale digesta het 'n verlaging in lisien, metionien en valien gedemonstreer wanneer geroosterde of gebrande sonneblomoliekoek ingesluit is, wat beklemtoon dat hierdie AS steeds beskou word as eerste beperkend in melkbeesdiëte. In 'n opvolgstudie waar van dieselfde diëte gebruik gemaak is, is dieselfde tendense in melkproduksie, samestelling en droë materiaalinnome verkry. Opname van AS deur die melkklier soos gemeet deur die arteriële - veneuse verskil tegniek, was numeries laer vir koeie wat geroosterde of gebrande sonneblomoliekoek gevoer is, in vergelyking met die kontrole. Hierdie was in teenstelling met gepubliseerde resultate, maar moontlike redes was beperkte energievoorsiening, stadium van laktasie en 'n hoë insluitingsvlak, of die moontlikheid bestaan dat die AS nie beskikbaar was nie. Toekomstige proewe moet laktasiestudies insluit om hierdie vrae te omvang.