

**THE NUTRITIONAL VALUE OF BROILER LITTER  
AS A FEED SOURCE FOR SHEEP DURING  
PERIODS OF FEED SHORTAGE**

**BY**

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**SUBMITTED IN PARTIAL FULFILMENT OF THE  
REQUIREMENTS**

**FOR THE DEGREE**

**PhD (AGRIC)**

**IN THE FACULTY OF AGRICULTURE**

**UNIVERSITY OF PRETORIA**

**DECEMBER 1999**



## DECLARATION

I declare that this thesis is my own work. It is being submitted for the Doctor of Philosophy in the University of Pretoria. It has not been submitted before for any degree or examination at any other University.

A handwritten signature in black ink, appearing to be 'S. M. M. M.', written over a horizontal dashed line.

December 1999

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## ACKNOWLEDGEMENTS

My sincerest and heartfelt gratitude goes to the following people who made this study possible:

My study leader, Professor J.B.J. Van Ryssen of the Department of Animal and Wildlife Sciences, University of Pretoria under whose leadership, encouragement assistance this study was conducted. Thank you for helping me discover my research potential.

Dr. E.C. Webb for his guidance and assistance when carcass evaluation samples were collected, analyzed and data analyzed.

Dr. Van Niekerk for his assistance and advice

Dr. J.P. Pienaar for his guidance and supervision when one of the experiments was conducted at the Agricultural Research Council (Animal Nutrition) at Irene.

Mr. R. Coertze for his help with statistical analysis of some of the data.

Mr. Bertus Spreeth for his assistance with the laboratory analyses.

Ms. Sue Van Malsen of the University of Natal, Pietermaritzburg for her assistance with the laboratory analysis when an experiment was conducted at Ukulinga farm at the University of Natal, Pietermaritzburg.

The workers of the University of Pretoria Experimental Farm, Hatfield and Ukulinga Experimental Farm of the University of Natal, Pietermaritzburg for their support and assistance with the running of the trials.

The Foundation for Research Development, Universities of Pretoria and Natal for financial assistance for the study.

The Kellogg Foundation for making it financially possible for me to undertake a PhD program.

My wife, Grace and kids, Mxolisi, Nomsa, Peter and Sanelisiwe (Nelly) and Sabelo (brother's son) for allowing me to pursue my studies (up to this goal), encouragement and putting up with all the inconveniences of being without a father for such a long time.

My late parents who, although did not live long enough to see me finish this tall call, wished I could do a PhD.

My brothers and their families for being a constant source of encouragement and financial help.

The S.C.C.I.Z. Church-Ekuphileni for their financial support and encouragement during my studies.

Finally to all my friends for their encouragement and moral support.

May God bless all of you.

**ABSTRACT**

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by

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**ABSTRACT**

The primary objective of the study was to evaluate the use of broiler litter as a survival feed for sheep. In growth and partial digestibility studies South African Mutton Merino wethers were used to investigate the utilization of broiler litter in sheep and the consequences it could have on the animals. Prior to each trial the sheep were vaccinated against botulism and it was ensured that the litter was well dried and free of lumps or dead chickens.

The crude protein concentration of the broiler litter obtained from different sources was approximately 200 g/kg, which is low comparing to published results elsewhere in the world. A surprisingly low uric acid concentration was measured in the one sample analysed. The litter did not contain abnormally high copper concentrations. One consignment of litter contained apparently a substantial proportion of soil that



accumulated in the rumens and abomasums of the sheep. The selenium in the litter proved to be highly bio-available in sheep.

In the first trials the sheep were kept in individual feeding pens and were fed experimental diets containing pure broiler litter or litter plus 7.5 or 15 percent molasses. The activity of different plasma enzymes and concentration of blood metabolites were measured. After an average of 83 days the wethers were slaughtered and carcass, liver and kidney weights were taken. Histopathological analyses were done on the tissues. The addition of 15 percent molasses to the litter resulted in a significant increase in feed intake. None of the enzymes showed activities above normal, neither did any of the blood metabolites indicate any abnormality in the sheep. Histopathological analyses and weights did not differ among treatments. The sheep in all three treatments increased in weight.

In a partial digestibility trial apparent digestion coefficients of nutrients in broiler litter and litter plus molasses were determined at different sites of the digestive tract. The addition of 15 percent molasses increased rate of passage of nutrients through the digestive tract and thus total dry matter intake. The result was that the site of digestion of organic matter shifted from the rumen to the small intestine, where a significantly higher proportion of the organic matter was digested compared to the treatment of pure broiler litter. The advantages or disadvantages of such a shift is not clear, though the phenomenon was confirmed in a second trial.

Up to 50 percent of the nitrogen in pure broiler litter and the litter plus 7.5 percent molasses diet disappeared from the rumen. Although a higher proportion of the nitrogen in the 15 percent molasses diet disappeared in the lower tract, because of the higher intake the total quantity of nitrogen absorbed from the rumen was similar to those in the other two diets. It was concluded that the bodies of sheep consuming diets with such high levels of broiler litter are heavily burdened with the catabolism of the excessive ammonia absorbed from the rumen.

In a growth study where 0, 33, 66 and 85 percent broiler litter was included in the diets, the growth rate of the wethers decreased significantly at 85 percent litter diet compared to the others. This was most obvious during the first 37 days of the trial, while the differences disappeared when the litter was fed for a longer period. It seemed as if sheep required a longer period than normal to adapt to diets high in broiler litter. This was also apparent during the first trial. The internal organs of sheep on high litter diets were heavier than organs from sheep on the diets containing no or 33 percent litter. It was suggested that such a phenomenon would mean that more energy would be required to maintain animals on high litter diets than at the lower diets. This would be undesirable in a survival feeding situation. No abnormal blood enzyme and metabolite levels were obtained also in this trial. All sheep were slaughtered at reaching a live weight of 55 kg and a taste panel evaluated the tensile properties of the mutton. At the addition of 15 percent molasses slight deviations in taste were observed.

It has been concluded that during periods of food shortage, sheep could be fed successfully on high levels of broiler litter, provided certain precautions are taken, e.g. the animals are vaccinated against botulism and that the product is dry enough to inhibit pathogenic growth. It seems as if the intake of litter may have to be restricted to approximately 1.5 percent of body weight and that the addition of molasses would only be necessary when the litter intake is unacceptably low.

**KEYWORDS:** broiler litter, sheep, droughts, emergency feeding, digestion, growth, carcass quality, ammonia, volatile fatty acids, dry matter

## OPSOMMING

# **DIE VOEDINGSWAARDE VAN BRAAIKUIKENMIS AS VOERBRON VIR SKAPE TYDENS PERIODES VAN VOERSKAARSTE**

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Die hoofdoel van die studie was om die gebruik van braaikuikenmis as oorlewingsrantsoen vir skape te evalueer. In groei- en parsieë verteringsproewe is Suid-Afrikaanse Vleismerino hamels gebruik en die benutting en gevolge van die voer van braaikuikenmis is ondersoek. Die diere is vooraf teen lamsiekte ingeënt en daar is verseker dat die mis goed droog was en klonte en kuikenreste uitgesif is.

Die braaikuikenmis uit verskillende bronne het ruproteïenvlakke van ongeveer 200 g/kg droë materiaal bevat, wat laag was in vergelyking met oorsese waardes. 'n Merkwaardige lae vlak van uriensuur is in die een monster wat ontleed is, gemeet. Die kuikenmis het geen abnormale hoë vlakke koper bevat nie. Een besending mis het skynbaar groot hoeveelhede grond bevat, want die grond het in die rumen en abomasums van die skape aangesamel. Die selenium in die kuikenmis het 'n hoë bio-beskikbaarheid in die diere gehad.

In die eerste proewe is die diere in individuele voerhokke gehou en het proefrantsoene ontvang wat bestaan het uit suiwer braaikuikenmis, of kuikenmis plus 7.5 of 15 persent melasse. 'n Verskeidenheid van plasma-ensieme en bloedmetaboliete is tydens die proef ontleed. Na 'n

gemiddeld van 83 dae is die hamels geslag en karkas, lewer en niergewigte is gemeet. Monsters van die weefsels is ook vir histologiese evaluering geneem. Die byvoeging van 15 persent melasse tot die mis het 'n dramatiese verhoging in voerinnome tot gevolg gehad. Geen van die ensieme se aktiwiteite of die vlakke van bloedmetaboliete het egter enige abnormaliteite getoon nie. Die skape in al drie die behandelings het toegeneem in gewig. Histopatologiese ondersoeke en orgaangewigte het ook geen verskille tussen behandelings getoon nie.

In 'n partiële verteringsproef is die skynbare vertering van nutriënte in hoendermis en in mis plus melasse op verskillende punte in die spysverteringskanaal bepaal. Weereens het die byvoeging van melasse die inname van hoendermis drasties verhoog. Die byvoeging van 15 persent melasse het 'n betekenisvolle toename in spoed van deurvloei van spysverteringskanaalinhoud deur die spysverteringskanaal tot gevolg gehad. Dit het veroorsaak dat 'n betekenisvolle hoër persentasie van die organiese materiaal in die laer spysverteringskanaal verdwyn het as in die rumen, in teenstelling met die situasie by die lae of geen melassebyvoegingsgroepe. Die voor- of nadele van so 'n verskuiwing was nie duidelik nie. Die neiging is met 'n opvolgproef bevestig.

Tot 50 persent van die stikstof in hoendermis het met die suiwer hoendermis en 7.5 persent melasse diëte vanuit die rumen verdwyn. Hoewel 'n hoër persentasie stikstof van die 15 persent melasse diëte in die laer spysverteringskanaal verdwyn het, was die totale hoeveelheid stikstof wat uit die rumen absorbeer is, soortgelyk aan die van die ander twee diëte. Dit is afgelei dat die liggame van al die skape op die hoë braaikuikenmis diëte, swaar belas was met die metabolisering van die oormaat absorbeerde stikstof.

In 'n groeistudie waar 0, 33, 66 en 85 persent braaikuikenmis in die rantsoene was, is gevind dat die groei van hamels betekenisvol laer was as die dieet uit 85 persent kuikenmis bestaan het. Hierdie verskynsel was veral merkbaar tydens die eerste 37 dae van die proef, en het daarna feitlik verdwyn. Dit wou voorkom, ook uit die eerste proef, asof die skape 'n langer as normale periode nodig gehad het om by die hoë hoendermisdiëte aan te pas. Die inwendige organe van die diere op die hoë misrantsoene was swaarder as dié in die ander behandelings. Dit is voorgestel dat so 'n enegievereisende verskynsel tydens oorlewingsvoeding ongewens is en dat dit wenslik is dat laer vlakke van hoendermis verskaf moet word. Ook in hierdie proef is geen abnormale ensiem en bloedmetaboliëtvlakke waargeneem nie. Die skape in hierdie proef is almal op 'n eindgewig van 55 kg geslag en 'n proe-paneel het die smaaklikheid van die vleis evalueer. Teen die 15 persent melasse-byvoegings kon geringe smaakafwykings van die normale waargeneem word.

Daar is tot die slotsom gekom dat skape tydens tye van voedselskaarste suksesvol vir oorlewing op diëte wat hoë vlakke braaikuikenmis bevat, kan gedy. Sekere voorsorgmaatreëls is egter noodsaaklik, soos inenting teen lamsiekte, dat die produk droog moet wees en dat die misinnames laag moet wees, nie meer as 1.5% van liggaamsmassa nie. Die byvoeging van melasse mag slegs nodig wees as kuikenmisinname onaanvaarbaar laag is.