



Improving the Nutritive Value of Low Quality Roughage for Ruminants

by Ensiling with Citrus Pulp and Poultry Litter

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Abbreviations

ADF	Acid detergent fibre
ADL	Acid detergent lignin
AFRC	Agricultural and Food Research Council
°C	Degrees centigrade
cfu	colony forming unit
CP	crude protein
cm	centimetre
DE	digestible energy
DM	dry matter
FAO	Food and Agricultural Organisation of the United Nations
GE	gross energy
<i>In sacco</i>	in bag
<i>In vitro</i>	in glass
<i>In vivo</i>	in animal
IVOMD	<i>in vitro</i> organic matter digestibility
ME	Metabolisable energy
MJ	mega joule
ml	millilitre (10^{-3} L)
mm	millimetre

mM	millimole (10^{-3} Mole)
N	nitrogen
NDF	Neutral detergent fibre
NE	net energy
NPN	Non-protein nitrogen
OM	organic matter
OMD	organic matter digestibility
Pre-mix	homogenous mixture of various ingredients
rpm	rotations per minute
sem	standard error of means
μl	microlitre (10^{-6} L)
VFA	volatile fatty acid

Summary

Investigations were completed on the effect of ensiling wheat straw with different proportions of citrus pulp, in the presence of poultry litter as a non-protein nitrogen source with or without molasses. The study evaluated quality of fermentation of the silage and also its nutritive value to ruminants on the basis of *in vitro* and *in sacco* digestibility. Animal response to the silage was also evaluated in an *in vivo* digestibility and nitrogen balance trial with Australian Merino sheep.

The four treatments containing wheat straw, poultry litter and citrus pulp respectively on a DM basis were T1 (75:25:0); T2 (60:25:15); T3 (45:25:30) and T4 (30:25:45). For each treatment between 5-10 kg of the thoroughly mixed material was ensiled for a period of 60 days, in 20 L hard plastic container laboratory silos. Inclusion of 5% molasses did not have any significant effect on pH, NDF, ADF, ADL or *in vitro* OMD. However, the presence of molasses resulted in a significant decrease in volatile fatty acids including N-butyric acid and a complete elimination of coliforms. Although, there was a significant difference in silage titratable acidity levels between silage_A with 0 and 5% molasses, the magnitude of the difference was small except in the silage with 30% citrus pulp. Increase in citrus pulp from 0 to 45% resulted in a very highly significant increase in silage acidity. There was no significant difference in pH between silage with 30 or 45% citrus pulp.

Wheat straw, poultry litter and citrus pulp silage ^{were} prepared in commercial quantities for both *in sacco* and *in vivo* studies and evaluation of any changes in fermentation quality. The results on composition and biochemical characteristics of the ensiled material before and after 60 days fermentation (time effect) showed a significant increase in titratable acidity, soluble nitrogen, ADF, ADL and ash content. However, there was a significant decrease in pH, DM and OM, in addition to a complete elimination of coliforms in the silage. The increase in the level of citrus pulp in the silage from 0 to 45% resulted in a highly significant increase in potential degradability of DM from 470 to 581.4 g/kg and the fractional rate of degradation from 0.027 to 0.062 per hour. In an *in vivo* experiment, the organic matter intake and digestibility increased ($p < 0.05$) with the level of citrus pulp in the diet. Silage with 30% citrus pulp included in the diet at 55.5% on DM basis resulted in the best performance for intake, digestibility and nitrogen retention.

It is was concluded from this study that ensiling wheat straw with about 25% poultry litter and 30 or 45% citrus pulp without molasses, could produce silage of relatively high fermentation quality and could provide ruminants with an inexpensive source of nutrients. However, the ration incorporating the silage needs to be well formulated and fortified with other non-ensiled ingredients, to correct any nutrient deficiencies in the diet and increase acceptability to the animals.

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Declaration

I hereby declare that this thesis contains no material that has been accepted for the award of another degree or diploma in any University and to the best of my knowledge and belief contains no material previously published or written by another person, except where due reference is made in the text.

I therefore, consent to this thesis being deposited in the University Library and be^{ing} made available for photocopying and loan.

Migwi, Perminus K.

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