

# Effect of pregnancy on intake, digestibility and digesta kinetics in heifers fed urea treated rice straws\*

**E.K. Masha<sup>1</sup>, A.E. Kimambo<sup>1,4</sup>, N. Kanuya<sup>2</sup>, D.M. Mgheni<sup>1</sup>,  
L.A. Mtenga<sup>1</sup>, M.R. Weisbjerg<sup>3</sup>, G.H. Laswai<sup>1</sup>, and T. Hvelplund<sup>3</sup>**

<sup>1</sup>Sokoine University of Agriculture, Department of Animal Science and Production  
P.O. Box 3004, Morogoro, Tanzania

<sup>2</sup>Sokoine University of Agriculture, Department of Veterinary Surgery and Therionology  
P.O. Box 3020, Morogoro, Tanzania

<sup>3</sup>Danish Institute of Agricultural Sciences, Department of Animal Nutrition and Physiology  
Foulum, P.O. Box 50, DK-8830 Tjele, Denmark

## ABSTRACT

Five rumen fistulated heifers weighing 298±4 kg, fed *ad libitum* urea treated rice straw were used during trimesters 1, 2, and 3 of pregnancy. Voluntary dry matter intake (VDMI), dry matter (DM) and neutral detergent fibre (NDF) digestibility, rumen pool sizes and passage rates were measured. Indigestible NDF was measured by long incubation *in situ* and used to derive digesta kinetics. The VDMI, digestion and passage rates for DM and NDF fractions, increased ( $P<0.05$ ) between the 1<sup>st</sup> and 3<sup>rd</sup> trimester. In conclusion, pregnant heifers fed high NDF based diets, maintains high forage intake by increasing digestion and passage rates.

KEY WORDS: heifers, pregnancy, intake, rumen pools, digesta kinetics

## INTRODUCTION

Forages fed *ad libitum* in ruminants appear to be constrained by physical fill in the rumen, particularly during pregnancy, causing reduction in feed intake (Forbes, 1970). In addition, pregnancy increase total nutrients requirements. Hence, it is most likely that pregnant cows in the tropics, where poor quality roughage forms the basal diet, have a mechanism of coping with the physical limitation to intake during pregnancy. This study was carried out to measure the effects of different stages of pregnancy on the rumen pool sizes and digestion kinetics and their subsequent effects on intake by heifers fed *ad libitum* on high fibrous diets.

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<sup>4</sup> Corresponding author: e-mail: kimambo@suanet.ac.tz; kimambo@hotmail.com

## MATERIAL AND METHODS

Five rumen fistulated (Boran × Friesian) heifers with mean body weight of 298±4 kg were synchronised for oestrus and bred using artificial insemination. Three experimental periods, based on pregnancy trimesters were between 7<sup>th</sup> and 11<sup>th</sup> weeks of pregnancy (Trimester 1), 19<sup>th</sup> to 23<sup>rd</sup> weeks (Trimester 2) and 32<sup>nd</sup> to 36<sup>th</sup> weeks (Trimester 3). In each trimester, the experimental period lasted for 28 days.

Animals were housed in pens and fed individually. Experimental diet consisted of rice straws treated with 50 g urea/kg DM in 600 ml of water per kg DM straw, covered with polythene sheet and ensiled for 14 days. Animals were fed *ad libitum* twice a day at 9.00 and 15.00 h and each supplemented with fish meal (200 g), minerals (100 g) and urea 20 g/100 kg body weight per day. Clean water was provided freely. Feed intake and *in vivo* digestibility were measured. Feeds were sampled at random. Rumen pool sizes of dry matter (DM) and neutral detergent fibre (NDF) were measured by rumen evacuation technique, whereas indigestible NDF (INDF) was determined by long incubation *in situ*, both as described by Mgheni et al. (2004). Rumen fractional rates of intake ( $k_i$ ), passage ( $k_p$ ) and digestion ( $k_d$ ) for DM, NDF and indigestible NDF were derived as described by Robinson et al. (1987). General Linear Model procedure of Statistical Analysis System (SAS) (1990) was used to analyse the data.

## RESULTS

The mean values of voluntary dry matter intake (VDMI), rumen pool sizes, DM and NDF digestibility as influenced by stage of pregnancy are presented in Table 1.

Table 1. The effect of stage of pregnancy on feed DM and NDF intake (kgd<sup>-1</sup>), digestibility (%) and rumen pool sizes, kg

Item	Stage of pregnancy (trimester) <sup>1</sup>			SEM	P	
	1	2	3			
DM	Intake	9.49 <sup>c</sup>	12.1 <sup>b</sup>	13.4 <sup>a</sup>	0.289	0.0001
	Digestibility	63.2 <sup>b</sup>	69.8 <sup>a</sup>	66.9 <sup>a</sup>	1.070	0.0001
NDF	Intake	7.17 <sup>c</sup>	8.45 <sup>b</sup>	9.43 <sup>a</sup>	0.143	0.0001
	Digestibility	80.09	82.5	80.13	0.007	0.0672
<i>Rumen pool sizes, kg, of:</i>						
DM		9.21 <sup>b</sup>	12.4 <sup>a</sup>	8.93 <sup>c</sup>	0.28	0.001
NDF		5.58 <sup>b</sup>	7.63 <sup>a</sup>	5.41 <sup>b</sup>	0.179	0.001
INDF		1.89 <sup>b</sup>	2.26 <sup>a</sup>	2.51 <sup>a</sup>	0.085	0.009

<sup>1</sup> in this and subsequent tables <sup>a,b,c</sup> means within rows with different superscripts are different (P<0.05)

There was an increase in DM and NDF intake between 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> trimesters. Apparent digestibility coefficients increased between 1<sup>st</sup> and 2<sup>nd</sup> trimester and decreased slightly between 2<sup>nd</sup> and 3<sup>rd</sup> trimester for DM, with no difference for NDF (Table 1). The rumen pool sizes of DM and NDF increased from 1<sup>st</sup> to 2<sup>nd</sup> trimester followed by a decrease from 2<sup>nd</sup> to 3<sup>rd</sup> trimester. The pool size of indigestible NDF increased progressively between 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> trimesters.

Derived rates of intake, digestion, passage and mean rumen retention time (MRRT) are presented in Table 2. Rate of intake for DM ( $k_i$ DM), NDF ( $k_i$ NDF) and INDF ( $k_i$ INDF) increased as pregnancy progressed from 1<sup>st</sup> to 3<sup>rd</sup> trimester. Rate of digestion for DM ( $k_d$ DM), NDF ( $k_d$ NDF) and digestible NDF (DNDF), ( $k_d$ DNDF) increased during the same period. Passage rates of DM ( $k_p$ DM), NDF ( $k_p$ NDF),  $k_d$ DNDF and INDF ( $k_p$ INDF) response were also similar during the same period. The MRRT increased between 1<sup>st</sup> and 2<sup>nd</sup> trimester and decreased between 2<sup>nd</sup> and 3<sup>rd</sup> trimester for DM, NDF and INDF, whereas MRRT for DNDF decreased with advanced pregnancy.

Table 2. Digestion kinetics for DM and NDF fractions at different stages of pregnancy

Rates, % h <sup>-1</sup>		Stage of pregnancy (trimester)			SEM	P-value
		1	2	3		
DM <sup>1</sup>	$k_i$	4.3 <sup>b</sup>	4.14 <sup>b</sup>	6.36 <sup>a</sup>	0.030	0.001
	$k_d$	2.8 <sup>b</sup>	2.9 <sup>b</sup>	4.3 <sup>a</sup>	0.080	0.001
	$k_p$	1.6 <sup>b</sup>	1.24 <sup>b</sup>	2.1 <sup>a</sup>	0.001	0.001
	MRRT (h)	64.26 <sup>b</sup>	81.42 <sup>a</sup>	48.03 <sup>c</sup>	3.740	0.050
NDF	$k_i$	5.45 <sup>b</sup>	4.71 <sup>c</sup>	7.37 <sup>a</sup>	0.001	0.001
	$k_p$	1.27 <sup>b</sup>	0.97 <sup>c</sup>	1.73 <sup>a</sup>	0.001	0.001
	$k_d$	4.18 <sup>b</sup>	3.73 <sup>c</sup>	5.65 <sup>a</sup>	0.001	0.001
	MRRT (h)	80.03 <sup>b</sup>	106.01 <sup>a</sup>	58.74 <sup>c</sup>	4.480	0.002
INDF	$k_i$	4.56 <sup>b</sup>	5.90 <sup>a</sup>	5.01 <sup>b</sup>	0.002	0.015
	$k_p$	2.23 <sup>a</sup>	1.90 <sup>b</sup>	2.01 <sup>ab</sup>	0.001	0.055
	MRRT (h)	43.30 <sup>b</sup>	52.67 <sup>a</sup>	50.06 <sup>ab</sup>	1.730	0.014
DNDF	$k_i$	5.94 <sup>b</sup>	4.25 <sup>c</sup>	9.60 <sup>a</sup>	0.003	0.016
	$k_p$	0.77 <sup>b</sup>	0.58 <sup>b</sup>	1.52 <sup>a</sup>	0.007	0.020
	$k_d$	5.17 <sup>b</sup>	3.67 <sup>c</sup>	8.08 <sup>a</sup>	0.002	0.010
	MRRT (h)	134.9 <sup>b</sup>	185.4 <sup>a</sup>	68.97 <sup>c</sup>	13.300	0.001

<sup>1</sup> $k_i$  = intake rate,  $k_p$  = passage rate,  $k_d$  = digestion rate, MRRT = mean rumen retention time

## DISCUSSION

The observed progressive increase in intake and rumen pool sizes with more or less similar digestibility coefficients, as pregnancy advances is contrary to what was expected. This mechanism was possibly contributed to the increased passage and digestion rates with reduced MRRT during the last trimester. The

current findings are in agreement with the work of Stanley et al. (1993) who reported increased VDMI and increased passage rate of 87% for indigestible acid detergent fibre (IADF) from 61 to 6 days before calving for Hereford × Angus cows consuming chopped lucerne hay. The results, however, are contrary to other findings of Journet and Remond (1976) that rumen contents and thus intake decreased proportionally with growth of foetus. The observed increase in rate of digestion of DM, NDF and DNDF between 1<sup>st</sup> and 3<sup>rd</sup> trimester can partly account for lack of well-known negative effects of increased passage rate on digestibility. In the present study, there is also a possibility of existence of rumen elasticity for fill that allowed space for increased intake.

## CONCLUSIONS

It is concluded that pregnant animals fed high NDF based forages adapt to these diets and maintain high feed intake by increasing digestion and passage rates as pregnancy progresses. It is therefore recommended that pregnant animals should be fed readily digestible forages to enable them extract sufficient nutrients as pregnancy advances between 2<sup>nd</sup> and 3<sup>rd</sup> trimester.

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