

The objective was whether the ability to digest fiber or to maintain protozoa would be influenced by varying the mixing rate of ruminal microbes. An orchardgrass hay-adapted ruminal microbial population was placed into twelve 500-ml fermenters and continuously cultured for 2 wk, 38 C, pH 6.5. Each culture was given 8.1 g ground orchardgrass hay 2x/d and infused with buffer to provide a 1.5 liquid volume turnover rate/d. The cultures were mixed at 88 rpm and sampled before the morning feeding after 5, 6, and 7 d. Three fermenters each were assigned to one of 4 groups contained an average of 9,670, 10,150, 8,230 and 7,180 protozoa/ml. The same cultures, when mixed at 38, 75, 150 and 300 rpm for an additional week and sampled as before, contained an average of 12,640, 6,690, 5,840 and 280 protozoa/ml, respectively. Numbers of cellulolytic bacteria (log 10/ml) after the 1st wk were 8.1, 7.7, 6.8 and 8.2 for the 4 groups, respectively. After the 2nd wk their numbers were not changed by mixing and were 7.5, 7.7, 7.6 and 8.6, respectively. The 14-d microbes from the 4 groups digested 62, 66, 66 and 66% of neutral detergent fiber (NDF) when batch cultured for 48 h. During d 5 to 7 of continuous culture, they digested 54, 55, 54 and 53% NDF compared with d 12 to 14 digestion of 72, 55, 62 and 67%, respectively. The latter digestion differences may be partially due to fiber pool size changes. On day 14, g fiber residue dry matter/fermenter was 8.4, 4.5, 4.8 and 6.5, respectively. A 48-h batch fermenter trial without buffer or feed did not give a differential effect of mixing on protozoa. It is concluded that mixing rates probably did not directly influence ruminal microbes, but influenced substrate and protozoal pool size by affecting substrate retention times during continuous culture.

**KEY WORDS:** Rumen, Protozoa, Cellulolytic bacteria, Fiber, Digestion, Artificial rumen, Mixing

647 Magnitude of the nutritional constraint to cattle production in a sahelian region of Africa. S.L. Louis \* and A. Sollod. NILP project, USAID/Iufts University, Niger.

In the sahelian animal production system which is based on the extensive communal range management, practices of animal feed production and conservation in support of the livestock industry are unknown. In the traditional herding, animal productivity measured by calving rate, mortality rate and daily growth rate is relatively low. The natural rangeland is composed primarily of annuals, few perennials, some forbs and a 5 % tree cover. The low biomass production (400-900 kg DM/ha in good years versus 0-150 kg DM/ha in drought years) coupled with extremely poor animal performances led to the study of the magnitude of the nutritional constraint. Grasses were sampled from the same locations in the pastoral zone during mid rainy season and mid dry season for a wide range of nutrients analyses. Of all the nutrients analyzed, crude protein (CP), phosphorus (P), vitamin A, and net energy (NE) contents were drastically reduced below the maintenance requirement for cattle. The poor performance of Azawak heifers during the dry season (0.1-0.3 kg weight loss/day/head) was due primarily to the deficiency of these nutrients in the forage consumed. CP content dropped from 5 to 1.1 %, P from 0.13 to 0.08 %, vitamin A from 4600 to less than 2000 IU/kg and NE from 1.033 to 0.664 Mcal/kg. Nutritional deficiencies which cause low productivity are occasionally compensated by *ad libitum* consumption of green shrubs and ligneous plants which, on the contrary, keep high content of these key nutrients during the crucial long annual drought. For example, *Acacia radiana*, *Balanites aegyptiaca*, *Maerua crassifolia* supplied nutritious forages with 18.2 % CP; 0.15 % P; 15,000 IU/kg of vitamin A; and 1.654 Mcal/kg of NE on the average. Forage reserves are being developed around boreholes and traditional wells as one cost effective and adapted means to allviate cattle malnutrition and to increase animal productivity in the Sahel.

**KEY WORDS:** Biomass production, nutrients, cattle production, sahelian region, animal productivity, drought.

648 Influence of fiber component levels of *Clitoria ternatea* and sorghum silages on intake and digestion by goats in Northeast Brazil. J. R. Kawas\*, H. Carneiro, M. Bezerra, F. A. V. Arruda, L. C. Freire, W. L. Johnson, and J. M. Shelton. Small Ruminant CRSP(US-AID) and Brazil National Goat Research Center (EMBRAPA), Sobral, CE.

Adjacent fields of *Clitoria ternatea* (CT) and forage sorghum (FS) were each divided in half. Early (E) and late (L) forages were harvested, ensiled, and fed *ad libitum* to 40 adult male criollo goats for 21 days in a randomized design. Silage analyses (% of dry matter) for neutral (NDF) and acid detergent fiber, crude protein and  $KMNO_4$  lignin were: ECT, 49.8, 34.7, 19.2, 9.8; LCT, 55.9, 34.6, 17.6, 10.7; EFS, 77.4, 48.8, 4.6, 8.4; and LFS, 69.3, 43.0, 4.9, 9.2. Total feces were collected for 7 days. Treatment means for voluntary intake (DMI) and apparent digestibility (DDM) of dry matter, digestible DMI (DDMI), and rumination (RuT) and eating (ET) time are shown in the table. DDM and DDMI decreased with advanced maturity

in both CT and FS. A greater DMI and DDM of EFS than of LFS may have been partially due to a greater NDF apparent digestibility (8.4 percentage units).

Silages	DMI <sup>1</sup> (g/kg <sup>0.75</sup> )	DDM (%)	DDMI (g/kg <sup>0.75</sup> )	RuT (Min/day)	ET (Min/day)
ECT	75.5 <sup>ab</sup>	66.8 <sup>c</sup>	50.8 <sup>a</sup>	407 <sup>b</sup>	369 <sup>a</sup>
LCT	77.2 <sup>a</sup>	59.8 <sup>d</sup>	46.0 <sup>a</sup>	474 <sup>ab</sup>	357 <sup>a</sup>
EFS	65.9 <sup>bc</sup>	77.4 <sup>a</sup>	51.0 <sup>a</sup>	554 <sup>a</sup>	285 <sup>b</sup>
LFS	59.6 <sup>c</sup>	72.3 <sup>b</sup>	43.2 <sup>a</sup>	575 <sup>a</sup>	254 <sup>b</sup>

Means in the same column with different superscripts differ ( $P < .05$ ).

<sup>1</sup>ECT and LCT, 42 and 70 days after a uniformization cut; EFS and LFS, milk and mature stages.

**KEY WORDS:** *Clitoria ternatea*, sorghum, fiber, intake, digestibility, goats.

649 Sodium bicarbonate and sodium bentonite supplements for growing cattle fed corn silage. K.K. Bolsen, D.E. Axe\*, K.A. Jacques, and D.L. Harmon. Kansas State University, Manhattan.

Two 84-day growing trials were used to measure the effect of sodium bicarbonate ( $\text{NaHCO}_3$ ) and sodium bentonite (SB) on performance of cattle fed corn silage diets. In trial 1, eight pens (four cattle/pen) were fed supplements with: 1) no additive (control); 2)  $\text{NaHCO}_3$ ; and 3) SB. In trial 2 six pens (four cattle/pen) were fed control and  $\text{NaHCO}_3$  supplements.  $\text{NaHCO}_3$  and SB were fed at 1.0% and 2.0% of the dietary DM intake, respectively. Silages were fed *ad libitum* with .91 kg of supplement/animal/day; diets were 12.0% crude protein (DM basis); supplements provided 200 mg of monensin/animal/day; and intermediate cattle weights were taken at 28 and 56 days. In both trials, final and intermediate rates and efficiencies of gain were statistically similar for cattle fed control and  $\text{NaHCO}_3$  supplements. In Trial 1, cattle receiving SB had a slower overall daily gain ( $P < .05$ ) and were less efficient ( $P < .05$ ) during the final 28 days than cattle receiving the control.

Item	Trial 1* <sup>ab</sup> $P < .05$				Trial 2**		
	Control	$\text{NaHCO}_3$	SB	SE	Control	$\text{NaHCO}_3$	SE
Initial wt., kg	219 <sup>a</sup>	215 <sup>ab</sup>	216 <sup>b</sup>		213	215	
Avg. daily gain, kg	1.03 <sup>a</sup>	1.02 <sup>ab</sup>	.99 <sup>b</sup>	.02	1.07	1.08	.04
DM intake, kg	6.58	6.51	6.63	.23	6.87	6.91	.46
DM/kg of gain, kg	6.36	6.37	6.70	.10	6.44	6.41	.14

\*February 9 to May 3, 1984.

\*\*November 16, 1984 to February 8, 1985.

**KEY WORDS:** Corn silage,  $\text{NaHCO}_3$ , Bentonite, Growing Cattle

650 Effect of sodium bicarbonate and sodium bentonite on intake, digestion, rumen fermentation, and liquid and solid flow of forage sorghum silage diets. K.A. Jacques\*, D.E. Axe, T.R. Harris, D.L. Harmon, K.K. Bolsen and D.E. Johnson. Kansas State University, Manhattan.

Effects of sodium bicarbonate ( $\text{NaHCO}_3$ ) and sodium bentonite (SB) on rumen measurements were tested using growing rumen-fistulated steers in a 6x6 Latin square design.  $\text{NaHCO}_3$  at 1% and SB at 2% were added to either sorghum silage or silage plus 50% grain diets. Diets were supplemented to contain 11% protein, offered *ad libitum*, and consumed at 2.5-3% of body wt. Measurements included dry matter (DM) and water intake, digestibilities, and NDF disappearance from Nitex bags. Osmolality,  $\text{NH}_3\text{-N}$ , pH, D(-) and L(+) lactate, and VFAs were measured at 0, 1, 3, 5 and 7 h post-feeding. Cobalt EDTA and chromium mordanted fiber marked passage of fluid and DM, respectively.  $\text{NaHCO}_3$  increased intake of the 50% grain diet; while neither additive affected intake of all-silage diets. No differences in digestibility were seen for DM, OM, or NDF; while bentonite lowered ADF digestibility of the 50% grain diet. All 50% grain diets had lower starch and ADF digestibility than silage diets. SB lowered 24 h % NDF disappearance on the 50% grain diet; but rate constants for NDF disappearance did not differ among or between the silage and 50% grain diets. SB lowered mean rumen pH of the 50% grain diet, while SB in the all-silage diet lowered pH at 3 h. The 50% grain control gave higher  $\text{NH}_3\text{-N}$  concentrations than either additive at 1, 3, and 5 h. Rumen lactate concentrations were equal for all treatments and sampling times. Molar proportions of propionate were higher for all-silage than 50% grain diets at 0, 1, 3, and 7 h.