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SHORT COMMUNICATION

In Sacco Degradability Kinetics of Cumbu Napier (COBN-5) Fodder at Two Different Stages of Harvest

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ABSTRACT

In the present study, Cumbu Napier (COBN-5) fodder was evaluated for nutrient degradability *in sacco* using three rumen fistulated Murrah buffalo bulls (380 ± 9.36 kg BW) fed *ad libitum* COBN-5 fodder at two different stages (40 and 45 days) of harvest. The average *in sacco* disappearance values (%) of DM, CP, NDF and ADF were 80.49, 91.97, 74.11 and 73.79 after 72 h incubation in the rumen, respectively. The readily soluble fraction (a) for DM, CP, NDF and ADF was higher in the fodder harvested at 40 days, whereas, higher insoluble but degradable fraction (b) for DM, CP, NDF and ADF was reported in the fodder harvested at 45 days. Further, potentially degradable fraction, PD (a+b) for DM and CP was lower, and for NDF and ADF was higher in the fodder harvested at 40 days. The effective degradability (%) of DM, CP, NDF and ADF was higher in the fodder harvested at 40 days than in 45 days. Results indicated that COBN-5 fodder can be effectively included in the rations of livestock harvested at 40 days for effective utilization.

Keywords: COBN-5 fodder, Degradation kinetics, *In sacco* degradability, Stage of harvest

The ruminant sector provides a significant proportion of self-employment opportunities and forms a basis for supplementary income to most sections of India's agrarian society. Forages usually constitute the major portion of the ruminant feeds and high quality nutritious green fodder is required to exploit the productive potential of dairy animals. With the increase in industrialization, ever-increasing population pressure of human beings, there is a little chance of having good arable land available for cultivation of green fodder. To meet the current level of livestock production, cultivation of perennial fodders which can yield higher biomass per unit area with early harvesting period is the immediate solution.

A number of breeding programmes came into force for evolving best quality green fodder. Hybrid Napier varieties proved to be promising fodders for their high yielding capability and usage as forage for livestock (Woodard and Prine, 1991). Cumbu Napier (COBN-5) fodder is a newly developed hybrid Napier variety by Tamil Nadu Agricultural University (TNAU) at Coimbatore and released for commercial cultivation in 2013 (Babu *et al.,* 2014). The yield data from research station trials showed a higher fodder yield in COBN-5 (3260 q/ha/yr) compared to CO-3 (2960 q/ha/yr). A key measure of the nutritive value of feedstuffs is digestibility, either *in vitro* or *in vivo* (Minson, 1990). Data on chemical composition, ruminal degradation and their relationships determine the economic value of forage (Weiss, 1994). The time of harvest also effects the chemical composition and nutrient degradability of forage inside the rumen. It is very important to know the proportion of dry matter or protein or fibre that is degraded in the rumen in certain times (Topps, 1996). The *in sacco* degradability is the best available method for estimating digestibility similar to *in vitro* disappearance and it is easy to perform (Weiss 1994). Therefore, the present study was undertaken to ascertain the *in sacco* degradability of DM, CP, NDF and ADF in COBN-5 fodder at two different stages of harvest.

Cumbu Napier (COBN-5) fodder was procured from the cultivated fields of Livestock Farm Complex (LFC), NTR College of Veterinary Science,

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Gannavaram. First cut was done after 75 days of plantation. Subsequently, the fodder was harvested on 30, 35, 40, 45 and 50 days in the second cut and is used for nutritional evaluation. Chemical composition (AOAC, 2007) and forage fibre constituents (Van Soest *et al.,* 1991) of the fodder were evaluated. Further, *in sacco* degradability of DM, CP, NDF and ADF was estimated in the rumen (Orskov and Mc Donald, 1979) using COBN-5 fodder harvested at 40 and 45 days.

Three adult rumen fistulated Murrah buffalo bulls (380 ± 9.36 kg BW) maintained on COBN-5 fodder were used to determine the *in sacco* degradability of DM, CP, NDF and ADF in COBN-5 fodder harvested at 40 and 45 days. The COBN-5 fodder was chaffed, dried and ground in a Wiley mill (2 mm size mesh screen) for incubation in the rumen. The pre-weighed nylon bags (13.5 cm x 7.5 cm), containing 5 g of feed were incubated for 0, 3, 6, 12, 24, 48 and 72 h in the ventral sac of rumen. The bags containing samples for 0 h were washed without incubation in rumen. The bags with feed samples incubated in the rumen were drawn in a sequential removal method (Osuji *et al.,* 1993). After removal, the bags were washed under slow running tap water by rubbing between fingers and the thumb for ten minutes, oven dried at 70°C for 48 h to constant weight and DM loss during the incubation was calculated. The CP, NDF and ADF content in the residue was analyzed to determine their respective degradabilities. From the degradability data obtained at different intervals, the constant a, b and c from the expression $P=a+b\ (1-e^{-ct})$ were obtained. Where, P is the degradability at time t, the constant, a is the intercept or instantly degradable fraction, b is the potentially degradable and c is the degradation rate or rate constant. The effective nutrient degradability (%) of crop residues, conventional and complete rations were calculated by time measurements and fitted values in NEWAY programme (Mc Donald, 1981) using a computer, assuming an outflow rate (K) of 0.05%/hr. The data was analyzed statistically (Snedecor and Cochran, 1994) using SPSS 17.0 version.

The chemical composition and cell wall constituents of COBN-5 fodder harvested at different days is presented in Table 1. Data revealed that the

Table 1. Chemical composition (% DM basis) of COBN-5 fodder at different days of harvest

Nutrient	Days of harvest					
	30	35	40	45	50	Mean ± SE
Dry matter	16.68[a]	17.02[a]	17.42[ab]	18.03[b]	20.54[c]	17.94±1.09
Organic matter	82.49[a]	84.27[b]	86.05[c]	87.20[cd]	88.17[d]	85.64±1.61
Total ash	17.51[a]	15.73[b]	13.95[c]	12.80[d]	11.83[e]	14.36±1.61
Crude protein	14.00[a]	13.41[b]	13.02[c]	12.70[d]	12.10[e]	13.05±0.51
Ether extract	3.27[a]	2.90[b]	2.82[b]	2.72[c]	2.41[d]	2.82±0.22
Crude fibre	19.24[a]	23.07[b]	27.96[c]	30.50[d]	34.69[e]	27.09±4.30
Nitrogen free extract	45.98[a]	44.89[b]	42.25[c]	41.28[d]	38.97[e]	42.67±1.99
Neutral detergent fibre	62.00[a]	65.00[b]	67.06[c]	69.10[d]	73.38[e]	67.31±3.03
Acid detergent fibre	38.29[a]	39.26[b]	40.20[c]	41.64[d]	44.80[e]	40.84±2.41
Hemi-cellulose	23.71[a]	25.74[b]	26.86[c]	27.46[d]	28.58[e]	26.47±0.44
Cellulose	30.94[a]	32.61[b]	34.25[c]	36.70[d]	40.87[e]	35.07±2.97
Acid detergent lignin	4.97[a]	5.31[b]	5.68[c]	6.13[d]	6.54[e]	5.73±2.74
Silica	2.95[a]	3.17[b]	3.42[c]	3.69[d]	3.82[e]	3.41±0.25
Calcium (%)	0.74[a]	0.81[a]	1.15[b]	0.48[b]	0.47[c]	0.73±0.20
Phosphorus (%)	0.68[a]	0.51[a]	0.75[a]	0.45[b]	0.44[b]	0.57±0.10

Each value is a mean of 3 observations; [a,b,c,d,e]Values in the rows bearing different superscripts differ significantly (P<0.05)

protein content was higher, while NDF, ADF and lignin were lower in Cumbu Napier fodder at 40 days of harvest as compared to 45 days. Forage age is the most influential factor on animal response parameters when forages form the main source of diet for ruminants. The fodder harvested at 40 and 45 days is studied *in sacco* by incubating in the rumen upto 72 h. The average *in sacco* disappearance values (%) and degradation kinetics of DM, CP, NDF and ADF in COBN-5 fodder is presented in Tables 2 and 3.

Data revealed that as the period of incubation extended from 0 to 72 h in the rumen, the *in sacco* disappearance (%) values of DM, CP, NDF and ADF increased progressively and higher values were observed in the fodder harvested at 40 days compared to that harvested at 45 days with non-significant differences. The rapidly soluble fraction (a) was higher, while the insoluble but degradable fraction (b), potentially degradable fraction (a + b) and rate constant/h (c) were lower in DM in the fodder harvested at 40 days (Table 2). Further, ED (0.05%$^{-h}$) of DM was higher in the fodder harvested at 40 days. Similar findings were reported by other research workers (Abdul Razak *et al.,* 1996; Tessema and Baars. 2004) in Napier grass. The rapidly soluble fraction 'a' and ED (0.05%$^{-h}$) of CP was higher in fodder harvested at 40 days, while the insoluble but degradable fraction 'b' was higher in the fodder harvested at 45 days (Table 2). Further, decreases in protein content was caused by an increase in stem proportion (Gutteridge and Shelton, 1994), which had a lower protein percentage than leaves, and there will be a reduction in leaf and stem fraction with age. Muia *et al.* (2001) reported similar values for fractions 'b' and 'c' but lower values for 'a' and ED of CP in Napier fodder compared to the values in present study. The higher fraction 'a' and lower 'b' fraction in the present study indicates presence of more soluble nitrogen content as compared to other Napier varieties. The effective degradability of CP was higher than the other Napier grass variety suggesting high degradable nitrogen content (Kabi *et al.,* 2005) in COBN-5 fodder. Higher fraction 'a', (a+b) and ED (0.05%$^{-h}$) of NDF were reported in the fodder harvested at 40 days compared to fodder harvested at 45 days. The lower

Table 2. Average *in sacco* disappearance (%) and degradation kinetics of DM and CP in COBN-5 fodder at 40 and 45 days of harvest

Parameter	DM			CP		
Days of harvest	**40**	**45**	**Mean ± SE**	**40**	**45**	**Mean ± SE**
Incubation period (h)						
0	38.37	37.04	37.70±0.67	55.18^{a}	53.47^{b}	54.33±0.86
3	40.47	39.20	39.83±0.64	62.99^{a}	60.49^{b}	61.74±1.25
6	48.00	46.97	47.49±0.52	69.74^{a}	67.84^{b}	68.79±0.95
12	57.23	51.87	54.55±2.68	73.85^{a}	71.73^{b}	72.79±1.06
24	70.05	67.49	68.77±1.28	79.05^{a}	75.41^{b}	77.23±1.82
48	77.46	72.55	75.05±2.45	88.73^{a}	86.12^{b}	87.43±1.31
72	82.54	78.44	80.49±2.05	92.10^{a}	91.84^{b}	91.97±0.13
Degradation Kinetics						
a	38.37	37.04	37.70±0.67	55.18^{a}	53.47^{b}	54.33±0.86
b	43.98	50.27	47.12±3.15	39.33^{a}	44.56^{b}	41.95±2.62
c	0.056	0.024	0.04±0.02	0.036^{a}	0.024^{b}	0.030±0.01
PD (a+b)	82.35	87.31	84.83±2.48	94.51^{a}	98.03^{b}	96.27±1.76
ED (0.05%/h)	58.50	54.20	56.35±2.15	76.10^{a}	74.80^{b}	75.45±0.65

Each value is a mean of 3 observations; ^{a,b}Values in the rows bearing different superscripts differ significantly P<0.05

Table 3. Average *in sacco* disappearance (%) and degradation kinetics of NDF and ADF in COBN-5 fodder at 40 and 45 days of harvest

Parameter	NDF			ADF		
Days of harvest	**40**	**45**	**Mean ± SE**	**40**	**45**	**Mean ± SE**
Incubation period (h)						
0	25.34[a]	18.98[b]	22.16±3.18	19.11[a]	14.46[b]	16.79±2.32
3	30.16[a]	24.36[b]	27.26±2.90	25.39[a]	19.14[b]	22.27±3.13
6	36.20[a]	32.05[b]	34.13±2.08	33.77[a]	26.74[b]	30.26±3.52
12	44.98[a]	42.64[b]	43.81±1.17	44.69[a]	38.46[b]	41.58±3.11
24	63.13[a]	53.78[b]	58.46±4.68	61.01[a]	52.96[b]	56.99±4.02
48	71.54[a]	62.08[b]	66.81±4.73	71.42[a]	63.24[b]	67.33±4.09
72	76.54[a]	71.68[b]	74.11±2.43	76.52[a]	71.06[b]	73.79±2.73
Degradation Kinetics						
a	25.34[a]	18.98[b]	22.16±3.18	19.11[a]	14.46[b]	16.79±2.32
b	52.41[a]	52.48[a]	52.45±0.04	58.11[a]	57.05[b]	57.58±0.53
c	0.0501[a]	0.0449[b]	0.048±0.001	0.0530[a]	0.0478[b]	0.05±0.002
PD (a+b)	77.75[a]	71.46[b]	74.61±3.15	77.22[a]	71.51[b]	74.37±2.86
ED (0.05%/h)	48.90[a]	43.10[b]	46.00±2.90a	46.74[a]	39.99[b]	43.37±3.38

Each value is a mean of 3 observations; [a,b]Values in the rows bearing different superscripts differ significantly P<0.05

ED (%) of NDF in the fodder harvested at 45 days might be due to higher cellulose and acid detergent lignin content (Table 3). The potentially degradable fraction of elephant grass was reported to be lower than the value in the present study (Gallardo *et al.,* 2010) in Napier grass. The rapidly soluble fraction (a), insoluble but degradable fraction (b) and PD (a+b) of ADF were higher in the fodder harvested at 40 days. Further, the effective degradability of ADF was higher in the fodder harvested at 40 days (Table 3). Lower potential degradability values were reported for elephant grass than the values observed in the present study (Gallardo *et al.,* 2010; Singh *et al.,* 1992). Decreased ADF degradability in late cut forages, may be attributed to presence of higher lignified fibre. Further, as forage matures its content of less digestible nutrients decreases (Bosch et al, 1992).

It was concluded that the COBN-5 fodder was better utilized in terms of *in sacco* nutrient degradability harvested at 40 days as compared to 45 days. This, will help to use the fodder for animal feeding at early stages of harvest, minimizing the cost of cultivation practices. Hence, the fodder can be better utilized by including it in the rations of livestock starting at 40 days of harvest for economical feeding.

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