A NOTE ON PROTEIN REQUIREMENT OF FRIESIAN COWS FOR MAINTENANCE IN A TROPICAL ENVIRONMENT

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ABSTRACT

Four dry non pregnant Friesian cows averagely weighing 376 ±19.2kg were in a 4 x 4 Latin square design, assigned to four dietary treatments: (A) hay *(Digitaria ezilis)*, (B) hay plus brewers dried grains, (C) brewers dried grains plus 5% molasses and (D) brewers dried grains plus 10% molasses, to assess the protein requirement for maintenance.

The mean metabolic faecal nitrogen (MFN) and endogenous urinary nitrogen (EUN) values were 0.361 ± 0.022g/100g DM intake and 0.079 ± 0.024g/day /$W^{0.75}$kg respectively. The mean biological values (BV) were 53.5 72.4, 58.4 and 58.1 for treatments A, B, C and D. These MFN, EUN and BV values facilitated the use of factorial equation, which gave average daily digestible crude protein (DCP) requirement for maintenance as 1.45g/$W^{0.75}$kg (0.94 – 2.85).

Key words: Protein requirements maintenance, Friesian, Tropical environment.

INTRODUCTION

As an attempt to augment the acute shortage of good quality animal protein in the diets of most Nigerians, Friesian and other exotic breeds, have been introduced into the country. The animals are either crossed with the local breeds or maintained as pure breeds.

There is paucity of information on the requirements of exotic breeds managed under tropical conditions. Most of the available data (Wagner and Loosli, 1967, Gardner and Park, 1973) have been derived from dairy cows in their natural environment, believed to be applicable to cows in the tropics. The nutritive values of most tropical pastures and feeding stuffs, differ markedly from those of temperate regions. it could therefore be misleading to base the requirements for maintenance and

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production of dairy cows on standards, recommended for animals in the temperate region.

The purpose of this study was therefore to estimate the minimum protein requirements for maintenance of -non-lactating, non-pregnant Friesian cows offered hay, plus brewers dried grains (BDG) and BDG supplemented with 5 or 10% molasses.

MATERIALS AND METHODS

Four non lactating, non pregnant Friesian cows ranging in weight from 200 – 500kg (376±19.2kg) were used in the study. The animals were dewormed with thiobendazone at the beginning of the study. Each cow was kept in a metabolism cage (Oyenuga, 1961) slightly modified for easy separation of urine and faeces The experiment was divided into four periods and there were four diets: A (Hay, *Digitaria exilis),* B (hay 50% BDG 50%), C 9bdg plus 5% molasses) and D (BDG plus 10% molasses). The four cows were kept on a different diet during each period. The design was thus a 4 x 4 Latin square (Cockran, Autrey, and Cannon, 1941). The animals were weighed before and after each experimental period, which lasted 21 days, made up of 14 days preliminary feeding, followed by a 7 -day collection period, Urine and faeces were collected separately each morning before feeding. Urine was collected from each cow in a polythene bucket wetted with 2 – 3ml of 10% mercuric chloride and placed beneath the metabolism cage The daily urine volume was measured and 10% of the total bulked for each animal and stored in a deep freezer at –5°C until required for chemical analysis. A representative sample (10%) of the total faeces voided per day was dried in a forced-draught oven at 70°C for 36 hours. These daily stored samples were then bulked at the end of each collection period, milled in a Christy and Norris mill and stored in airtight bottles, until required for chemical analysis.

Bulked feeds, and faeces samples were milled and analysed for their proximate compositions and pooled urine samples were analysed for nitrogen (A O.A.C., 1975). Nitrogen of metabolic origin in the milled faecal samples was determined, (Van Soest and Wine, 1967) as modified (Mason, 1969). digestible crude protein (DCP) requirements were estimated by ARC (1965) factorial equation, as fully discussed (Adegbola, Mba and Olubajo, 1975). The truly absorbed nitrogen was also obtained (Adegbola *et al.*, 1976).

RESULTS

The proximate chemical compositions of acha hay *(Digitaria exilis)*, brewers dried grains and molasses are shown in Table 1. The crude protein content (%) of the hay diet and molasses was relatively low at 4.3 and 2.6 respectively, as against 20.6% of BDG.

Tables 2 and 3 show the summary of nitrogen utilization data by the cows fed rations A, B, C or D respectively. From Table 2, it was observed that the cows on ration B consumed significantly greater ($P<0.05$) quantities of N than the mean values for the other treatment groups. The faecal nitrogen output (g/day) was highest ($P\angle 0.05$) for cows on ration B, probably due to increased nitrogen intake. The variations observed for the urinary – N loss (g/day) among

Table 1.

CHEMICAL COMPOSITION OF RATION COMPONENTS FED TO FRIESIAN COWS

	DIETS		
NUTRIENTS (%)	*Acha hay*	*Brewers dried grains*	*Molasses*
Dry Matter	94.5	90.0	80.60
Organic Matter	87.5	86.5	77.6
Crude Protein	4 3	20.6	2.62
Ether Extract	0.63	6 8	0.17
Crude Fibre	43 5	30.5	
Nitrogen-Free Extractives	39.07	28.6	74.81
Ash	7.0	3.5	3.0
Gross Energy (Kcal/g DM)	4.75	6.30	4.34

cows on the hay diet and those on BDG – supplemented with molasses, were not significant. However, animals on treatment B consumed greater mean N (g/day) and excreted appreciable amount of N in the urine per day. Similarly, cows on treatment B absorbed the highest N compared with those on any of treatments A, C and D. The apparent differences in N absorption by cows on treatments A, C and D, were not however, significant. The nitrogen retention percentage values indicated that more nitrogen was retained by cows on treatment B than those on any other treatment. However, cows on the hay diet retained the least percent N. Apparent digestibility coefficients for N indicated higher values for BDG supplemented with molasses, than the hay alone or hay and brewers grains combinations.

The metabolic faecal nitrogen (MFN) values were, 3.15, 3.35, 3.76 and 4.10g N/kg DM intake, for animals on treatments A, B, C and D respectively. The overall mean value was 3.61±0.23g N/Kg DM consumed. The endogenous urinary nitrogen (EUN) was estimated from the regression equations relating urinary–N (Y) and absorbed–N (X). The integcept of the regression line on the Y – axis of the graph relating urinary nitrogen to truly absorbed nitrogen, both variables being expressed on metabolic size ($W^{0.75}$ kg) basis (which allows pooling of the data for body weight variables), is an estimate of the minimum endogenous urinary nitrogen g/day/$W^{0.75}$ kg) (Brody and Procter, 1932). Values of 0.15, 0.04, 0.07 and 0.06 for cows on treatments A, B, C and D respectively were obtained, the

Table 2.

SUMMARY OF NITROGEN UTILIZATION DATA BY FRIESIAN COWS MAINTAINED ON FOUR DIETARY TREATMENTS (MEAN ± SE)

Parameters	Treatments *A*	*B*	*C*	*D*
Mean Liveweight ($W^{0.75}$ **kg**)	70.12 ± 9 83	72.50 ± 9.08	72.33 ± 8.86	72.33 ± 7.27
DM Intake (g/day)	4532.35 ± 206	5955.88 ± 731.0	1131.38 ± 216.86	1539.23 ± 124 04
Nitrogen-intake (g/day)	31.18± 1.42	122.70± 15.59	35.48 ± 6.78	46.30 ± 3.73
Faecal Nitrogen (g/day)	14.95± 0.79	46.42± 5.28	8.87 ± 2.72	12.48 ± 3.71
Urinary Nitrogen (g/day)	14.33± 0.82	26.46± 3.10	13.01 ± 2.97	16.37 ± 0.85
Nitrogen balance (g/day)	1.91± 0.68	49.82± 7.96	13.60 ± 2.97	17.45 ± 1.38
Metabolic Faecal-N (g/day)	14.27± 3.40	19.35± 1.24	4.49 ± 1.28	5.11 ± 0.59
Absorbed-Nitrogen (g/day)	30.51± 3.14	96.68± 11.08	31.10 ± 5.65	38.94 ± 0.83
N--Retention (%)	6.14± 2.09	40.07± 1.82	37.63 ± 3.07	34.29 ± 4.75
Apparent N--digestibility (%)	52.19± 0.43	61.78± 1.88	76.13 ± 4.17	74.36 ± 5.61
Apparent DM digestibility (%)	73.92± 1.93	59.45± 2.98	63.53 ± 4.16	60.81 ± 8.64

A = Acha hay; B = 50% acha plus 50% brewers dried grains; C = 95% brewers dried grains plus 5% molasses;D = 90% brewers dried plus 10% molasses; SE = Standard Error.

Table 3.

NITROGEN UTILIZATION DATA BY FRIESIAN COWS MAINTAINED ON FOUR DIETARY TREATMENTS

	Treatments				
	A	*B*	*C*	*D*	*Mean*
Metabolic Faecal Nitrogen (g/N/kg DM intake)	3.15	3.35	3.76	4.19	3.61±0.23
Endogenous Urinary Nitrogen (g/day/$W^{0.75}$ kg).	0.15	0.04	0.07	0.06	0.079±0.024
*Biological Value (BV) (%)	53.50	72.37	58.40	58.10	60.60±4.08
**DCP for Maintenance (g/$W^{0.75}$ kg).	2.85	0.94	1.05	0.98	1.45±0.46
DCP for Maintenance (g/day/kg liveweight)	3.88	1.28	1.42	1.33	1.98±0.63

$$^{*}BV = \frac{NI - (FN - MFN) - (UN - EUN)}{NI - (FN - MFN)} \times \frac{100}{1}$$

Where NI = Nitrogen intake
FN = Faecal Nitrogen
UN = Urinary Nitrogen
MFN = Metabolic Faecal Nitrogen
EUN = Endogenous Urinary Nitrogen

**DCP (Digestible Crude Protein) for Maintenance g/day/$W^{0.75}$ kg (ARC, 1965).

$$= 6.25 \left[\left(EUN \times \frac{100}{BV} \right) + MFN \left(\frac{100}{BV} - 1 \right) \right]$$

Where EUN = Endogenous Urinary N (g/day/$W^{0.75}$ kg)

MFN = Metabolic Faecal – N (g/day/$W^{0.75}$ kg) variations were not significant giving a mean of 0.08±0.02 g/day/$W^{0.75}$ kg).

The biological value (BV) of tne diets were estimated by the application of the Thomas– Mitchell (1924) formula. The values were 53.5, 72.4, 58.4 and 58.1 for animals on treatments A, B, C and D respectively. The differences were not significant. The relationship between N--balance (g/day/$W^{0.75}$ kg) and absorbed–N (g/day/$W^{0.75}$ kg) in the present study was not significant and the correlation coefficient was quite low. The digestible crude protein (DCP) required for maintenance, that is, the amount of DCP intake required to keep the animal in hypothetically zero N–balance, were 2.85, 0.94. 1.05 and 0.98 g/day/$W^{0.75}$ kg for cows on treatments A, B, C and D respectively with a pooled mean of 1.45±0.46g/day/$W^{0.75}$ kg).

The results showed that the DM intake by cows on treatments A and B were significantly higher ($P \angle 0.05$) than the mean values for those on either C or D. Apparent digestibility values recorded for DM varied from 59.45 to 73.92 percent The differences were not however significant.

DISCUSSION

The recorded increase in N consumption with increased total DM intake was similar to observation reported elsewhere (Mba *et al,* 1975, Pachauri and Negi 1980) The present digestibility of N increased with increasing levels of BDG in the rations that is to say, with crude protein This observation is also in agreement with reports (Robinson and Forbes 1970 Andrew and Crskov, 1970), where increased digestibility of dietary crude protein was observed with increasing levels of dietary crude protein.

The observed increase in faecal N output with increased N intake is comparable to such report (Roy 1969), which showed that faecal–N exretion inceased with increasing proportion of N intake. Similarly, the observed increase in urinary nitrogen output with increasing consumption of dietary N as observed (Pilgrim *et al.*, 1969), indicated that urinary–N output as a percentage of N intake was strongly dependent upon the level of N intake.

The observed increase in N absorbed with increasing levels of dietary intake agrees with other reports (Stobo and Roy, 1973, Adegbola, *et al.*, 1976). Treatment effects on MFN values (g/100g DM intake) were not significant. The pooled mean value of 0.364g/100g DM consumed was lower than the corresponding value of 0.5g often quoted for ruminants (A, R.C., 1965; Maynard and Loosli, 1966) 0.49g for steers (Greenhalgh, 1959) and 0.460g for cattle fed on all roughage diet (Elliot and topps, 1963) and 0.344g (Adebowale, 1976). The present mean endogenous urinary value compares favourably with the values recorded elsewhere (Hamilton *et al* 1948 1948, Ikhatua and Olubajo, 1979). The observed value was however lower than the value reported for cattle weighing over 200kg (A.R.C., 1965, N.R.C., 1968) or lambs (Walker and Faichney, 1964). Wide variations in endogenous urinary nitrogen values have been attributed to urea recycling effects (Packett and Groves, 1965. Robinson and Forbes, 1966).

The results of the biological value (BV) showed that the cows on hay plus brewers dried grains had the highest BV of 72.4% which compares with the value of 70% reported for cattle (Devendra and Burns, 1970). However the observed value for the hay treatment alone was lower than the vaue of 65.0%

quoted for ruminants, maintained on all roughage ration (A.R.C , 1965, Maynard and Loosli, 1969).

The present overall mean DCP value for maintenance (1.45g/day/$W^{0.75}$ kg) is higher than the range 0.70 to 0.89 DCP/day/kg liveweight for dairy cows (Webster and Wilson, 1966). The result is however comparable with the value of 1.68g DCP/day/kg liveweight (Pachauri and Negi, 1980). The present mean value of DCP is about 40 percent of Brody's (1945) recommended value of 4.8g/ day/kg liveweight. Elliot and Topps (1964) observed that the generally accepted standards for digestible N for maintenance appears to be excessive by a factor of 3 when compared to African breeds of sheep, fed diets adequate in energy The present value is less than brody's (1945) recommendation, but, in general, agrees with the observations of Elliot and topps (1964). This however seems to indicate that Friesian cows maintained under tropical environment would likely require more protein for maintenance, than that normally recommended for them in their natural environment.

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