

Validation of Energy Estimates of Urea Ammoniated Sugarcane Trash Based Diets Obtained from RIVIGPT and *In-vivo* Trial in NariSuwarna X Kenguri F1 lambs

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ABSTRACT: The energy estimates of various experimental diets fed to NariSuwarna X Kenguri F1 lambs with urea ammoniated sugarcane trash (USCT) and GMG/CFM were obtained from digestion trial (DT) and rumen *in vitro* incubation for gas production (RIVIGP), fifteen lambs were divided into five groups of three each. five treatment combinations with urea ammoniated sugarcane trash (USCT) and CFM used to meet the growth requirements Lambs [2] at maintenance level (T-1) and to support 50 (T-2), 100 (T-3), 150 (T-4) and 200g (T-5) daily body weight gain. The feeding trial was carried out for the duration of 140 days in switch over design for five periods. Each period digestion trial conducted with an adjustment period of three weeks and collection period of one week. The metabolisable energy (ME, MJ kg⁻¹ DM) content of diets at maintenance level of intake obtained by DT for T-1, T-2, T-3, T-4 and T-5 were 7.66, 8.25, 8.96, 8.93 and 10.08 respectively. The corresponding ME values obtained from RIVIGP were 9.8, 9.75, 10.28, 10.78 and 11.00 respectively. The difference between the ME obtained from DT (digestion trial) and ME predicted from RIVIGPT was found to be 14.98 per cent. The mean ME output (Maintenance + weight gain) for the treatments T-1, T- 2, T-3, T- 4 and T-5 were 5.66, 5.72, 6.70, 7.15 and 6.52 respectively. The ME intake estimated from ME obtained from DT and RIVIGP for treatments T-1, T- 2, T-3, T- 4 and T-5 were 4.95 and 6.17, 5.47 and 6.24, 6.63 and 7.44, 6.87 and 8.13, 7.62 and 8.24 respectively. Hence, the observed performance of NariSuwarna x Kenguri F1 lambs expressed in terms of the total ME output was accountable to the extent of 100.6 and 87.6% of ME intake estimates obtained from ME values derived by DT and RIVIGP respectively.

KEYWORDS: RIVIGPT, digestion trial, ME, urea ammoniated sugarcane trash, lambs

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I. INTRODUCTION

In vivo digestion trials were conducted to estimate the metabolisable energy content of feed stuffs like sugarcane trash (SCT), urea ammoniated sugarcane trash (USCT) and Ground maize grain (GMG) / concentrate feed mixture (CFM). But animal experiments are laborious, time consuming and requires large quantity of feeds which is not suitable for large scale feed evaluation. Therefore several alternative methods were proposed to estimated energy content of feeds than digestion trial. Hohenheim *In vitro* gas production technique is widely accepted and adopted

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method for evaluation of feeds to predict metabolisable energy [5]. *In vitro* gas production technique is less expensive and less time consuming when compared to *in vivo* digestion trials. But ME content of feeds varied with the region, therefore region wise *in vitro* studies conducted and the energy values used for feed or diet formulation [4]. Evaluation of *in vitro* incubation gas production technique to predicted energy content of various feeds and validation through *in vivo* in different species of ruminants are limited especially for feedstuffs of tropical regions [6]. Hence, the feeding cum digestion trial was conducted in NariSuwarna X Kenguri F1 lambs to validate energy estimates of urea ammoniated sugarcane trash based diets obtained from *in vitro* incubation for gas production technique (RIVIGPT) through *in vivo* digestion trials.

II. MATERIALS AND METHODS

Fifteen NariSuwarna X Kenguri F1 lambs aged 3 to 7 months and average body weight of 15.80 kg were selected and divided into five groups of three each in switch over design for five periods. Each period consisted of four weeks duration, thus total duration of the experiment-I was 20 weeks (140 days). The digestion trial in each period with an adjustment period of three weeks and collection period of one week. The lambs were housed in well protected raised metabolic cages in experimental shed and provided similar care and management. The diet of the experimental lambs comprised of urea ammoniated sugarcane trash as a sole roughage source and the CFM formulated to meet the growth requirements Lambs [2] at maintenance level (T-1) and to support 50 (T-2), 100 (T-3), 150 (T-4) and 200g (T-5) daily body weight gain. Supplementation of GMG for T-1 group and CFM to other treatments to meet growth requirements. Weekly body weight recorded on two consecutive days between 8.00 a.m. to 9.00 a.m. before having access to feed and water. The samples of experimental diets that offered and left over were collected daily for determination of dry matter. The digestion trial lasted for 5 days during which daily intake of USCT and output of dung and urine were collected to assess nutrient digestibility and nitrogen balance of growing lambs under different treatment. The pooled samples of feed and ground dung were analyzed for proximate constituents, fiber fractions, nitrogen content, DOMD and ME were estimated.

Chemical analyses

The samples of roughage, CFM and fecal samples were analyzed for proximate analysis [1]. While the fiber fractions NDF, ADF and ADL were determined as per the method described by [8].

In vitro studies

The feeds (roughage and CFM) fed to NariSuwarna X Kenguri F1 lambs were subjected to *in vitro* rumen incubation studies to evaluate for metabolisable energy content [5].

Donor cow and collection of rumen fluid

A Deoni bull weighing 250 kgs aged 3 years, fitted with a flexible rumen canula of large diameter (Bar Diamond, Inc. USA), receiving a basal diet consisting of sorghum stover and concentrate feed mixture (Maize-50 % , Soybean meal-20.5 % , Wheat bran-25 % , DCP -2.0, Mineral mixture-1.0 % , Salt-0.75 % , Vitamin-0.25 % , Sodium bi carbonate-0.5 %) was used for the donor animal for rumen fluid. The sorghum stovers and concentrate were fed separately; the sorghum stovers were offered 3 kg in small portions 4 times in a day, starting at 9.30 AM. The concentrate was offered 1.0 kg per day in two equal portions at 6 AM and 1.30 PM. Drinking water was offered three times a day and 2 hours before rumen fluid collection. Rumen fluid was collected in the morning between 9.00 to 9.30 AM, before offering roughage.

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Incubation

The samples of USCT and CFM collected from digestion trials were subjected to *in vitro* rumen incubation by incubating 200 mg air equilibrated feed samples with 30ml buffered rumen fluid in 100 ml calibrated syringes placed in a water bath at 39°C. Each time the necessary corrections were made for the difference in the activity of rumen liquor by parallel incubation of reference standards. Incubations were run for 24h with recording of gas production at 2, 4, 6, 8, 10, 12, 16, 20 and 24 of incubation.

Calculation of energy value

Digestion trial: Digestion coefficient of organic matter, digestible organic matter in dry matter (DOMD) was calculated as an alternative to total digestible nutrients (TDN). DOMD/TDN was converted to ME by a factor of 0.15 (1 kg DOMD/TDN=18.45 MJ of DE, ME=0.82 DE, i.e. 1 kg TDN/DOMD=15.1 MJ of ME).

RIVIGPT: Using proximate composition and *in vitro* net gas production (corrected for blanks and reference standards) at 24h incubation, ME in diets were calculated by equations (1) and (2) according to [5].

Roughages

$$ME = 2.2 + 0.1357 GP + 0.0057 CP + 0.0002859 EE^2 \quad (1)$$

Concentrate supplements

$$ME = 1.06 + 0.1570 GP + 0.0084 CP + 0.022 EE - 0.0081 TA \quad (2)$$

Where, ME is metabolisable energy in MJ kg⁻¹ DM, GP the Gas production (ml/200 mg DM); CP, EE, TA are crude protein, ether extract and total ash, respectively, in g/kg DM.

Comparison of energy values obtained by RIVIGPT and digestion trial

The ME in USCT and CFM determined by RIVIGPT and the energy output by experimental lambs in the form of maintenance and gain in body weight were computed for the observed body weight by using [2] requirements. The extent to which these estimates would account for the observed energy output in lambs were examined. The energy output in the form of maintenance and gain in body weight were computed for, the observed body weight averaged for the entire feeding trial by using [2] requirements [Maintenance, MJ/day=1.7265+ (0.159x kg Body weight); weight gain=18.49MJ/kg gain for 20 kg body weighing lambs] and compared with energy intake. Energy intake is obtained from multiplying DMI for the entire feeding trial by the corresponding energy estimates obtained by digestion trial and RIVIGP.

III. EXPERIMENTAL RESULTS AND DISCUSSION

Comparison of energy values obtained by digestion trial and RIVIGPT

The chemical composition of the urea ammoniated sugarcane trash and CFM used in the trial were presented in Table 1. The mean body weights of NariSuarana x Kenguri lambs, DMI, ME obtained from digestion trial, ME calculated at maintenance level of intake and ME obtained from RIVIGPT were presented in Table 2. The metabolisable energy (ME, MJ kg⁻¹ DM) content of diets at maintenance level of intake obtained by DT for T-1, T-2, T-3, T-4 and T-5 were 7.66, 8.25, 8.96, 8.93 and 10.08 respectively. The corresponding ME values obtained from RIVIGP were 9.8, 9.75, 10.28, 10.78 and 11.00 respectively. The difference between the ME obtained from DT (digestion trial) and ME predicted from RIVIGPT was found to be 14.98 per cent. The energy content of a variety of Indian feedstuffs obtained by RIVIGPT was within 15 per cent of the values reported for feedstuffs [4]. The observed performance of NariSuarana x Kenguri F1 sheep fed sugarcane trash based complete diets expressed in terms of the

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total ME output was accountable to the extent of 97.0 and 99.6% of ME intake estimates obtained from ME values derived by DT and RIVIGP respectively [3].

Table 1. Chemical composition (% on DMB) of Urea ammoniated SCT, Ground maize grain and Concentrate feed mixture

Composition	USCT	GMG	CFM
DM	74.53	91.85	91.18
OM	86.60	93.07	92.07
CP	11.98	10.45	29.72
EE	1.70	1.87	1.96
CF	34.17	1.10	2.11
NFE	38.74	79.65	58.27
TA	13.40	6.93	7.93
AIA	9.73	1.35	0.68
NDF	78.80	16.49	18.96
ADF	52.65	4.79	7.72
ADL	17.27	0.61	0.66
Cellulose	33.07	3.18	5.78
Hemicellulose	26.15	11.71	11.24

Note: USCT: Urea ammoniated sugarcane trash; GMG: Ground maize grain; CFM: Concentrate feed mixture

Table 2. Mean body weights (kg)^a, DMI (g day⁻¹) and ME (MJ kg⁻¹) obtained from digestion trial (DT) and RIVIGP for the diets used in digestion trial^b.

Treatment	B.Wt.	DMI			ME			RIVIGPT	% difference
					DT				
		RDMI	CDMI	TDMI	ME (observed)	ME intake (Mx)	ME at 1x		
T-1	21.13	410.82	218.34	629.15	7.87	0.85	7.66	9.80	21.79
T-2	20.72	398.85	241.47	640.32	8.54	0.91	8.25	9.75	15.38
T-3	21.27	379.09	344.24	723.32	9.17	1.12	8.96	10.28	12.87
T-4	21.36	331.4	423.13	754.53	9.11	1.17	8.93	10.78	17.15
T-5	19.62	296.91	452.59	749.51	10.17	1.36	10.08	11.00	8.39
Mean	20.82	47.95	104.92	699.4	8.97	1.08	8.78	10.32	14.98
±SE	±0.52	±21.44	±46.92	±26.97	±0.38	±0.09	±0.40	±0.25	±2.23

^a Mean of 10 animals; ^b Mean of 10 observations; Mx= Multiple of maintenance; ME at 1x = [ME observed + (Mx-1) 0.6].

Assessment of potentials of energy estimates obtained from digestion trial and RIVIGPT

The observed performance of NariSuwarna x Kenguri growing lambs expressed in terms of total energy output and the energy intake estimates obtained from the energy values derived from DT and RIVIGP are presented in Table 3. The mean ME output (Maintenance + weight gain) for the treatments T-1, T- 2, T-3, T- 4 and T-5 were 5.66, 5.72, 6.70, 7.15 and 6.52 respectively. The ME intake estimated from ME obtained from DT and RIVIGP for treatments T-1, T- 2,

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T-3, T-4 and T-5 were 4.95 and 6.17, 5.47 and 6.24, 6.63 and 7.44, 6.87 and 8.13, 7.62 and 8.24 respectively. Hence, the observed performance of NariSuwarna x Kenguri F1 lambs expressed in terms of total energy output was accountable to the extent of 100.6% of the energy intake obtained from energy estimates derived from DT. Whereas the energy intake estimates obtained from the energy values derived from RIVIGP, the energy output accounted for 87.6% of the energy intake. A study conducted on growing ram lambs reported 98% (DT) and 90% (RIVIGP) was accountable to the observed performance [7]. The performance of NariSuwarna x Kenguri F1 sheep fed sugarcane trash based complete diets expressed in terms of the total ME output was accountable to the extent of 97.0 and 99.6% of ME intake estimates obtained from ME values derived by DT and RIVIGP respectively [3]. Hence, the ME values obtained by RIVIGP were comparable to ME values obtained by DT in accounting for the observed energy output with in $\pm 15\%$ in this study indicates the potential for application of this technique for evaluating tropical ruminant feedstuffs for ME values and further this data can be utilized for diet formulation in small ruminant feeding.

Table 3: Mean body weight (kg), DMI (kg day⁻¹), gain (g day⁻¹) and calculated ME Output (MJ day⁻¹) compared with ME intake obtained from energy estimates from DT and RIVIGP for five diets used in feeding trial.

Diet	Body weight	DMI			Gain	ME output	ME intake	
		USCT	CFM	Total			DT	RIVIGP
T-1	21.13	0.411	0.218	0.629	30.95	5.66	4.95	6.17
T-2	20.72	0.399	0.241	0.640	37.74	5.72	5.47	6.24
T-3	21.27	0.379	0.344	0.723	85.95	6.70	6.63	7.44
T-4	21.36	0.331	0.423	0.755	109.52	7.15	6.87	8.13
T-5	19.62	0.297	0.453	0.750	90.48	6.52	7.62	8.24
Mean	20.82	0.05	0.10	0.06	70.93	6.35	6.31	7.24
SE	± 0.52	± 0.02	± 0.05	± 0.03	± 14.14	± 0.26	± 0.44	± 0.41
Mean ME output % of intake							100.6\pm4.25	87.6\pm2.15

However, the number of experimental diets tested in this experiment were too small, the results of this study can only be an indication to further application of *in vitro* technique for evaluating the ruminant feedstuffs for energy content in larger numbers and the same data may be used to formulate diets for ruminants.

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