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Jaishankar N
Associate Professor, Department of Animal Nutrition, KVAFSU, Bidar, Karnataka, India

Ramachandra B
Professor and Head, Department of Animal Nutrition, KVAFSU, Bidar, Karnataka, India

Thirumalesh T
Professor and Head, Department of Animal Nutrition, KVAFSU, Bidar, Karnataka, India

Corresponding Author
Jaishankar N
Associate Professor, Department of Animal Nutrition, KVAFSU, Bidar, Karnataka, India

Effect of urea ammoniated sugarcane trash based diets on growth potentiality of Nari Suwarna × Kenguri F1 lambs

Jaishankar N, Ramachandra B and Thirumalesh T

Abstract
Fifteen lambs fed *ad libitum* urea ammoniated sugarcane trash (USCT) as basal diet, the group fed ground maize grain (GMG) at maintenance level (T-1) as control, other groups fed with concentrate (CFM) for 50g gain (T-2), 100g gain (T-3), 150g gain (T-4) and for 200g gain (T-5) per day as per ICAR requirements to assess growth, intake and digestibility in lambs. The ADG and DMI improved linearly upto T-4; voluntary intake of USCT was around 2% of body weight. OM, CP, EE and NFE intake significantly increased with higher CFM intake and no significant difference with intake of CF, NDF, ADF, cellulose and hemicellulose. The digestibility of DM, OM, CP, EE and NFE increased significantly but didn't affect CF digestibility. Observed positive nitrogen balance in all groups. It is concluded that USCT with CFM supplements improved ADG, DMI and digestibility and lambs has potentiality to gain 100 g per day.

Keywords: lamb, sugarcane trash, urea, growth, digestibility

1. Introduction
Efficient utilization of crop residues is one of the thrust area in ruminant nutrition to mitigate the shortage of feed resources. Among several crop residues, sugarcane trash (SCT) is unconventional dry leaves around cane, which is almost burnt on the sugarcane field after the harvest of sugarcanes (Jaishankar *et al*, 2017). Crop residues are low nutritive value, low digestibility and low voluntary intake (Saritha *et al*., 2012) due to interlocking of cell wall polysaccharides with lignin and higher levels of silica (Mahesh and Mohini, 2013). Therefore urea ammoniation is considered to be method of choice for improving the feeding value of straws (FAO, 2002) that improve nutritive value of poor quality roughages. Hence, the present experiment was designed to evaluate the effect of urea ammoniated sugarcane trash as a source of roughage on growth performance of NariSuwarn×Kenguri F1lambs.

2. Materials and Methods
Fifteen NariSuwarna × Kenguri F1 lambs of around 3rd to 7th month age were divided into five groups of three lambs each. Each group was randomly allotted to one of the five dietary treatments in a switch over design with uniform managemental care. Each period consisted of four weeks duration for five periods, thus total duration of the experiment was 20 weeks (140 days). 4% urea (w/w) with 40% water was used for urea ammoniation of chaffed sugarcane trash. The diet of the experimental lambs comprised of urea ammoniated sugarcane trash as a sole roughage source and the concentrate feed mixture formulated to meet the growth requirements. Lambs were fed as per ICAR (2013) [9] at maintenance level and to support 50, 100, 150 and 200g daily body weight gain. The roughage USCT was supplied *ad libitum* based on the previous weeks average roughage intake of individual animal, the quantity of concentrate feed supplied was adjusted to meet the specific growth requirements as recommended by ICAR (2013) [9]. The treatments were designated as T - 1, T - 2, T - 3, T - 4 & T - 5 and descriptions of the treatments are as follows:

Treatment 1: Free choice feeding of USCT and ground maize grain (GMG) at maintenance level as control group.

Treatment 2: Free choice feeding of USCT and concentrate feed mixture (CFM) for 50g daily body weight gain.

Treatment 3: Free choice feeding of USCT and CFM for 100g daily body weight gain.

Treatment 4: Free choice feeding of USCT and CFM for 150g daily body weight gain.

Treatment 5: Free choice feeding of USCT and CFM for 200g daily body weight gain.

2.1 Digestion trial and chemical analysis
At the end of the each period, two lambs from each group were subjected to metabolic trial for five days. Dung and urine voided by each lamb over 24 hours was weighed/measured every day at 9.00 AM. The pooled samples of feed, fodder and dung were analyzed for proximate constituents according to AOAC (2005) [2] except for crude fibre fractions. The crude fiber fractions, neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined according to Van Soest *et al.* (1994) [19]. The DOMD and ME were calculated as per methods described by Fuller (2004) [6].

2.2 Statistical analysis
The data were analyzed statistically using analysis of variance technique in randomized block design. The data on feeding trial and metabolism trial was subjected to statistical analysis using SAS programme (SAS, 2010) [18] and interpreted accordingly.

3. Results and Discussion
3.1 Chemical composition
The chemical composition of sugarcane trash and CFM used in growth trial are presented in Table 1. The results of the proximate analysis and the forage fibre fractions of the sugarcane trash are compared to values reported by Franco *et al*, (2013). The chemical composition of sugarcane trash was similar to other crop residues like sorghum stover (Ramachandra *et al*. 2002) [16], Maize stover (Hirut *et al.* 2011) [8]. The CP, ADF and cellulose contents of urea ammoniated sugarcane trash increased but decreased in CF, NFE, NDF, ADL and hemicelluloses contents when compared to untreated sugarcane trash. Marginal increase in CP content of USCT was due to addition of urea as NPN source for ammoniation of sugarcane trash and decrease in NDF, ADL and hemicelluose was due to solubilisation of hemicellulose during ammoniation.

Table 1: Chemical composition (% on DMB) of SCT, USCT, GMG and CFM

Composition	SCT	USCT	GMG	CFM
OM	88.63	86.60	93.07	92.07
CP	3.04	11.98	10.45	29.72
EE	1.46	1.70	1.87	1.96
CF	34.73	34.17	1.10	2.11
NFE	49.40	38.74	79.65	58.27
TA	11.37	13.40	6.93	7.93
AIA	11.62	9.73	1.35	0.68
NDF	79.09	78.80	16.49	18.96
ADF	50.27	52.65	4.79	7.72
ADL	20.75	17.27	0.61	0.66
Cellulose	29.29	33.07	3.18	5.78
Hemicellulose	28.82	26.15	11.71	11.24

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

3.2 Body weight gain
The ADG of NariSuwarna × Kenguri F1 lambs of treatment groups are presented in Table 2. NariSuwarna × Kenguri F1 lambs fed 50, 100, 150 and 200 g/d but the lambs gained less than targeted gain. Even though lambs in T-1group was fed only GMG as supplement for maintenance shown improvement in gain, which might be due to supplementation of fermentable energy through maize grain. The concentrate feed mixture fed to support 150 g gain per day in (T-4) group gained higher than T-5 group. ADG reduction in T-5 due to more concentrates and less roughage intake that affected rumen microbial biomass synthesis. This clearly indicated that NariSuwarna × Kenguri F1 lambs had only the genetic potentiality of gain up to maximum of an average of 100 g gain/day.

3.3 Dry matter intake
The total dry matter intake (g/d), on% body weight and on metabolic body weight (g/kg $BW^{0.75}$) is presented in Table 2. The total DMI was significantly higher in T-4 and T-5 followed by T-3, T-2 and T-1. The treatment T-5 had significantly ($P<0.01$) lower roughage DMI when compared to other groups. Whereas no significant difference either on% BW or g/kg $BW^{0.75}$ between treatment groups. Significantly higher DMI from CFM was observed in T-5 group followed by T-4, T-3, T-2 and T-1 which was due enhanced palatability of concentrates than roughage. The same trend was noticed both on% body weight and metabolic body weight. But significantly lower DMI from roughage was observed with the increased proportion of CFM in the diets as this could not be avoided as roughage and CFM were fed separately. The similar results were observed by Kiflay Welday (2012) [11], Abebe Gemechu *et al.* (2015) [1] and Fitsum Abera *et al.* (2016) [5].

Table 2: Body weight gain and dry matter intake in NariSuwarna X Kenguri F1 lambs

Parameters (Mean values)	T-1	T-2	T-3	T-4	T-5	SEM	P-value
Body weight (kg)	20.74^{ab}	21.30^{b}	21.57^{b}	21.23^{b}	20.02^{a}	0.44	<0.01
Body weight gain (g/d)	30.95^{a}	37.74^{a}	85.95^{b}	109.52^{b}	90.48^{b}	5.33	<0.01
Total DMI (g/d)	629.15^{a}	640.32^{a}	723.32^{b}	754.53^{b}	749.51^{b}	14.10	<0.01
% BW	3.08^{ab}	3.02^{a}	3.39^{bc}	3.60^{cd}	3.75^{d}	0.05	<0.01
g/kg BW$^{0.75}$	65.28^{a}±	64.61^{a}	72.60^{b}	76.82^{bc}	79.15^{c}	1.00	<0.01
Roughage DMI (g/d)	410.82^{c}	398.85^{bc}	379.09^{bc}	331.40^{ab}	296.91^{a}	18.20	<0.01
% BW	2.00	1.83	1.77	1.56	1.44	0.07	NS
g/kg BW$^{0.75}$	42.36	39.44	37.97	33.44	30.61	1.61	NS
Concentrate DMI (g/d)	218.34^{a}	241.47^{a}	344.24^{b}	423.13^{c}	452.59^{c}	16.41	<0.01
% BW	1.09^{a}	1.19^{ab}	1.62^{bc}	2.04^{cd}	2.31^{d}	0.08	<0.01
g/kg BW$^{0.75}$	22.92^{a}	25.17^{ab}	34.63^{bc}	43.38^{cd}	48.53^{d}	1.71	<0.01

Note: *P*<0.01, Mean values bearing different superscript in a row differ significantly

3.4 Nutrient intake

The mean intake (g/d) of OM, CP, EE, CF, NFE, NDF, ADF, cellulose, hemicelluloses is presented in Table 3. T-4 and T-5 had significantly (*P*<0.01) higher OMI and CPI when compared to other groups. However it increased linearly as CFM proportion was increased in the diet. Therefore, as the CFM quantity increased in the diet CP intake also increased proportionally. But, there was no significant difference between the groups for intake of CF, NDF, ADF, cellulose and hemicelluloses. Because of variation in the composition of fiber fractions. Similar results were reported by several authors Melese *et al.* (2014) [13], Abebe *et al.* (2015) [1] and Merhun *et al.* (2016) [14].

Table 3: Mean Nutrient intake (g/d) in NariSuwarna X Kenguri F1 lambs

Parameter	T-1	T-2	T-3	T-4	T-5	SEM
OM (g/d)	558.97^{a}	567.72^{ab}	645.23^{bc}	676.57^{c}	673.83^{c}	12.49
% BW	2.74^{a}	2.68^{a}	3.02^{b}	3.23^{bc}	3.38^{c}	0.05
CP (g/d)	72.03^{a}	119.55^{b}	147.72^{c}	165.46^{d}	170.08^{d}	4.70
% BW	0.35^{a}	0.57^{b}	0.69^{c}	0.79^{d}	0.86^{d}	0.02
EE (g/d)	11.07^{a}	11.51^{a}	13.19^{b}	13.93^{b}	13.92^{b}	0.26
% BW	0.05^{a}	0.05^{a}	0.06^{ab}	0.07^{b}	0.07^{b}	0.001
CF (g/d)	142.78	141.38	136.80	122.17	111.01	6.01
% BW	0.69	0.65	0.64	0.58	0.54	0.02
NFE (g/d)	333.06^{ab}	295.22^{a}	347.44^{b}	374.94^{b}	378.75^{b}	7.29
% BW	1.64^{b}	1.40^{a}	1.63^{b}	1.79^{bc}	1.91^{c}	0.03
NDF (g/d)	359.73	360.08	363.99	341.37	319.78	12.50
%BW	1.75	1.67	1.70	1.62	1.57	0.05
ADF (g/d)	226.75	228.64	226.16	207.15	191.27	8.83
% BW	1.10	1.06	1.06	0.98	0.94	0.03
Cellulose Intake (g/d)	142.80	145.86	145.26	134.05	124.35	5.47
% BW	0.70	0.67	0.68	0.63	0.61	0.02
Hemicellulose Intake (g/d)	133.00	131.44	137.82	134.22	128.51	3.77
Intake% BW	0.650	0.613	0.644	0.638	0.637	0.01

Note: *P*<0.01, Mean values bearing different superscript in a row differ significantly

3.5 Digestibility of nutrients and Nitrogen balance

T-5 registered significantly (*P*<0.05) higher DM and OM digestibility when compared to T-1 and T-2. DMD and OMD improved linearly with gradual increase in CFM supplementation in T-3, T-4 and T-5 groups. Animals on CFM in general digested more of the nutrients in their diets than those fed straw alone. T-4 had significantly (*P*<0.01) higher CPD% when compared to T-1. Higher levels of CFM supplementation with USCT linearly increased digestibility of crude protein. This might be due to increased CP level and decreased the fiber content of the diets had improved the energy and protein supply to the animals that had improved nutrient balance and digestibility (Van Soest, 1994) [19].

The digestibility of CF, NDF, ADF, cellulose and hemicelluloses were non significantly varied between the treatments. Inclusion of urea ammoniated sugarcane trash didn't affect the digestibility of fiber. Dixon and Stockdale (1999) [3] opined that CFM intake contributed to reduction of rumen pH and cellulolytic bacterial activity, which decreased the digestion of fiber fractions. Hence, USCT can be incorporated as a sole roughage source in ruminant diet and didn't show any adverse effect on digestibility. Similar results reported by Fitsum *et al.* (2016) [5].

Table 4: Mean Digestibility of nutrients and Nitroten balance in NariSuwarna X Kenguri F1 lambs

Digestibility (%)	T-1	T-2	T-3	T-4	T-5	SEM
DM	53.40^{a}	57.92^{a}	61.96^{ab}	61.45^{ab}	69.21^{b}	1.51
OM	57.29^{a}	62.10^{ab}	66.24^{bc}	65.60^{abc}	72.95^{c}	1.45
CP	61.60^{a}	74.68^{b}	75.90^{b}	77.37^{b}	77.05^{b}	1.20
EE	48.36^{a}	56.13^{ab}	60.78^{bc}	60.44^{bc}	67.15^{c}	1.83
CF	52.98	58.72	55.33	52.23	56.12	1.25
NFE	55.65^{a}	57.69^{a}	65.36^{ab}	64.07^{ab}	75.60^{b}	2.07
NDF	45.86	48.43	48.07	44.93	52.27	1.21
ADF	36.60	39.14	35.88	35.36	43.58	1.60
Cellulose	47.50	51.55	48.05	46.88	53.96	1.57
Hemicellulose	46.55	43.34	47.20	50.43	51.42	1.42
N- balance						
Intake	11.63a	19.40b	24.04c	26.50d	28.35d	0.95
Outgo	8.69a	13.64b	14.79b	16.58bc	18.75c	0.63
Balance	2.94a	5.76a	9.24b	9.92b	9.60b	0.51

Note: *P*<0.01, Mean values bearing different superscript in a row differ significantly

3.6 Nitrogen balance

Significantly (*P*<0.01) higher nitrogen intake observed in T-4 and T-5 groups when compared to T-1, T-2 and T-3. Significantly (*P*<0.01) higher nitrogen outgo observed in T-4 and T-5 when compared to T-1, T-2 and T-3. Hence in treatment T-3, T-4 and T-5 observed (*P*<0.01) higher positive nitrogen balance when compared to T-1 and T-2. Various levels of CFM supplementation linearly improved nitrogen retention and had positive nitrogen balance, this might be due to improved rumen microbial fermentation and microbial biomass synthesis shown positive nitrogen balance that improved body weight gain. Similar results reported by Pratap Reddy *et al.* (1989) [15].

3.7 Nutritive value of diet

The treatment T-4 and T-5 had significantly (*P*<0.01) higher DCP level when compared to T-1 and T-2. Increased DCP values were observed when CFM levels supplemented to basal roughage USCT. This was due to higher digestibility of nutrients in concentrate supplements than roughage source. The treatment T-5 had significantly (*P*<0.05) higher DOMD% when compared to T-1 and T-2. DOMD was increased linearly with various levels of CFM supplementation. Improved DOMD was observed when linear increase in proportion of the CFM in diet, which increased CP level and decreased fiber content of diets and thus improved the energy and protein supply to the animals that improved nutrient balance and digestibility (Van Soest, 1994) [19]. T-5 had significantly (*P*<0.05) higher TDN% when compared to T-1 and T-2. Linear increase in TDN values observed when increased CFM levels supplemented to basal roughage USCT. The treatment T-4 and T-5 had significantly (*P*<0.01) higher ME intake when compared to T-1 and T-2. Improvement in ME values of diets was observed when various CFM levels supplemented to basal roughage USCT. This might be due to higher energy and protein content of CFM than USCT. ME intake was in increasing trend with higher levels of concentrate supplementation, this might be due to better palatability of concentrates and higher concentrate intake. Similar results were reported by Venkateswarlu *et al.* (2013) [20] and Getahun (2014) [7].

Table 5: Mean Nutritive value of diet in NariSuwarna X Kenguri F1 lambs

Parameter	T-1	T-2	T-3	T-4	T-5	SEM
DCP%	7.06^{a}	14.44^{b}	15.89^{bc}	16.96^{bc}	17.89^{c}	0.66
DOMD%	50.97^{a}	55.22^{ab}	59.24^{bc}	58.86^{abc}	65.73^{c}	1.38
TDN%	52.03^{a}	56.48^{ab}	60.62^{bc}	60.25^{abc}	67.29^{c}	1.42
ME* (MJ/kg DM)	7.87^{a}	8.54^{ab}	9.17^{ab}	9.11^{ab}	10.17^{b}	0.22
DCP intake (g/d)	23.82^{a}	51.92^{b}	70.64^{bc}	78.47^{c}	93.21^{c}	4.35
ME intake (MJ/d)	5.04^{a}	5.42^{ab}	6.63^{bc}	6.93^{c}	7.82^{c}	0.22

* ME calculated as 1kg TDN = 15.12 MJ of ME

Note: *P*<0.01, Mean values bearing different superscript in a row differ

4. Conclusion

The SCT was equal to any of the crop residues in nutritional composition and voluntary intake of USCT was 2% of the body weight and supplementation of ground maize grain supported above maintenance level. As proportion of CFM increased in the diet, the intake of USCT was progressively decreased but the digestibility of all the nutrients except CF was increased. CFM supplementation to USCT improved ADG, DMI, nutritive value and digestibility of nutrients in lambs and NariSuwarna × Kenguri F1lambs had potentiality to gain on average 100 g per day.

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