Tropical Agricultural Research Vol. 1 1989

Effects of Urea Ammonia Treatment and Urea Molasses Lick (mol-u-min) Supplementation of Rice Straw on Intake, Digestibility and Some Bio-chemical Parameters in Cattle

A.L. Badurdeen, S.S.E. Ranawana and M.N.M. Ibrahim

Postgraduate Institute of Agriculture,
University of Peradeniya.

ABSTRACT. To study the possibility of supplementing rice straw with urea molasses lick, a 4 x 4 Latinsquare experiment was carried out over four periods using four crossbred bull calves (Sahiwal x Indigenous) with an average body weight of 280 + 59 kg. and four diets namely; Untreated straw (US), US supplemented with urea molasses lick (US+), Urea ammonia treated straw (TS) and TS supplemented with urea molasses lick (TS+). Each periods were divided into 25 days of adaptation, 21 days of pre-experimental period followed by a experimental period of 12-15 days. Drymatter intake and digestibility were measured for 12 days within each period. Samples of rumen fluid was collected for the last three days while saliva and blood sample were taken on the last day of each experimental period. Both the blood and rumen fluid samples were analyzed for the concentration of Ca, Mg, Cu, Zn and Fe. In addition blood sample was analyzed for concentration of P, Serum protein, picked cell volume, numbers of red blood cell and concentration of haemoglobin. Also, rumen NH^3-N and pH of rumen fluid were measured. Saliva sample was subjected to analyze for Na and K concentration. All the results were statistically analyzed as affected by urea ammonia treatment, urea molasses lick supplementation and the interaction of these two.

Urea ammonia treatment increased the digestible drymatter intake (kg/100 kg.BW) of rice straw whereas urea molasses lick increased this only with TS. Rumen pH decreased while an increase in rumen ammonia concentration (Mg/100 ml) was observed by both urea ammonia treatment and urea ammonia lick supplementation. Urea ammonia treatment increased the Ca (mg/dl) and Fe (ug/ml) concentration in the rumen fluid. Supplementation of urea molasses lick had no effect on the concentration of minerals in the rumen fluid. However, supplementation of urea molasses lick increased the P concentration (mg/dl) in the blood. Though serum protein level (g/dl) was increased due to urea ammonia treatment

the red blood cell number (10^6/cm) reduced by supplementation of urea molasses lick. No changes were observed on other parameters studied.

Considering positive and negative aspects, it could be concluded that no urea molasses lick was superior than urea ammonia treatment. And hence this cannot be applied directly to the field condition in Sri Lanka.

INTRODUCTION

Evidence from literature indicate that supplementation with urea molasses either in the liquid or block form has yielded variable results (James and Theron, 1973 ; Dixon, 1984). More recently in India Kunju (1986) reported that supplementation of untreated straw with urea molasses lick (MOL – U – MIN) improved its digestibility to the level of urea ammonia treated straw. Also, he added that this was attributed to the provision of minerals, easily fermentable carbohydrate, a better rumen environment for microbial fermentation and provision of By – pass nutrients to animal for production.

If there is manipulation of rumen environment towards the optimum rumen fermentation there should have been an improvement in the digestibility of rice straw with lick than without lick. However, the observation made by Vincent Sewalt (1985) and the results of past work are not in favour of this expectation. Furthermore, if optimum conditions for rumen microbes are provided, at least the parameters such as rumen pH and rumen ammonia concentration should be in optimum level with lick supplementation.

Also, if by – pass protein and minerals are provided it seems reasonable to expect that the mineral levels in plasma or rumen fluid and/or plasma should reflect such changes.

Another argument is that the urea ammonia treatment reduced the availability of magnesium due to high ammonia concentration and there by may lead to a condition called hypomagnesaemia (Ranawana, 1985). In addition, lack of information on mineral status of the animal as affected by urea ammonia treatment tend to prolong this argument.

The general objective of this study was to evaluate whether urea molasses lick can be introduced to farmers level in Sri Lanka as in the

case of urea ammonia treatment provided it is freely available at an affordable price or produced locally. However, thc following specific objectives were made to draw evidence to support the final conclusion.

a) Confirming the results of the previous experiment on the effect of urea ammonia treatment and urea molasses lick supplementation on dry matter intake and digestibility of rice straw.

b) Comparing the change in pH, ammonia concentration and Ca, Fe, Cu, Zn and Mg concentration in the rumen fluid as affected by urea ammonia treatment and supplementation of urea molasses lick.

c) Comparing the change in the haemoglobin concentration, red blood cell count, PCV, MCV, MCHC and the content of minerals such as Ca, P, Mg, Cu, Zn and Fe in the blood due to urea ammonia treatment and supplementation of urea molasses lick.

d) Comparing the change in the molar ratio of Na and K in the saliva due to supplementation of urea molasses lick and urea ammonia treatment.

MATERIALS AND METHODS

Treatments

Treatments consisted of 4 diets, namely; untreated straw (US), US supplemented with urea molasses lick (US+), urea ammonia treated straw (TS) and TS supplemented with urea molasses lick.

The urea ammonia treated straw was prepared by mixing 100 litres of 4% urea solution with 100 kg of air dry straw. 4% urea solution was made by dissolving 4 kg of urea in 100 litres of water. Straw and urea solution were mixed thoroughly and stored under air-tight condition in a cement pit for 7 days. Continuous supply of treated straw was made available using 2 pit 7 days system of urea treatment.

Urea molasses lick (MOL - U - MIN) was a commercial preparation and imported from India.

Animals and experimental design

Four cross bred bull calves (Shiwal x Indigenous) with an average body weight of 280 $\pm$ 59 kg were fitted with rumen canula (internal diameter 4 cm) and housed in metabolism cages. In order to subject all the animals to all treatments, the experiment was repeated over 4 periods to form a 4 x 4 balanced Latin Square design.

Measurement and laboratory analysis

Each period consisted of 25 days of adaptation period and 21 days of pre-experimental period followed by a experimental period of 12 - 15 days. The animals were fed *ad libitum* at hourly intervals throughout the day and night. Urea molasses lick was offered separately in a specially made wooden box. Clean drinking water was available at all times.

During the experimental period, the daily amount of feed offered, refused and the amount of faecal out put were recorded. The dry matter content of straw offered, refused and faeces was determined by drying a representative sample in a forced draft oven at 100^{0}C 24 hours. Dry matter content of urea molasses lick was determined by drying a representative sample in a vacuum oven at 80^{0}C for 24 hours.

Samples of treated and untreated straw were collected daily and stored at -4^{0}C. At the end of collection period the samples were thoroughly mixed and a representative sample was oven dried at 70^{0}C for 48 hours. The dried sample was ground to pass through 1 mm seive. Also a sub-sample of lick block was taken at the beginning of the experiment.

The straw and lick block samples were analyzed for dry matter, ash, crude protein, Na, K, P, Cu, Zn, Fe and Mn. The lick block was also analyzed for Ca and Co.

During the last 3 days of the collection period, about 30 ml of rumen fluid was withdrawn by a 50 ml glass syringe through the canula. Rumen fluid samples were collected from 8 a.m. to 2 p.m. at 30 minutes intervals. Immediately after collection 5 ml sample was put in small bottles (in duplicate) containing 1 to 3 drops of concentrated sulphuric

acid. These samples were kept under refrigeration and later analyzed for rumen ammonia. Rest of the sample was used for rumen pH determination.

On the last day of each period blood sample was taken from the Jugular vein into a vacutainer. On the same day saliva sample was also collected thrice from the mouth. Saliva sampling was done by inserting a clean sponge roll into the mouth of the animals and the saliva from the sponge squeezed into small bottles.

Intake and digestibility measurements were not taken in the last day. Intake of urea molasses lick was calculated through a linear regression analysis.

The analysis of blood, and rumen fluid samples were carried out in the Veterinary Research Institute, Gannoruwa except rumen ammonia nitrogen and rumen pH determinations. These two analysis were done at the Department of Animal Science Laboratory.

Packed cell volume (PCV) or hematocrit, red blood cell count, concentration of haemoglobin and serum protein level were analyzed by micro hematocrit, improved neubourer haemocyto meter, cyanomethaeno – globulin and serum protein meter methods, respectively.

Mineral content such as Ca and P were measured by Variantechtron UV Vis Spectrophoto meter while Mg, Fe, Zn and Cu were analyzed by Variantechtron Atomic Absorption spectrophotometer.

Saliva sample was subjected only to measure Na and K content. The analysis was done by Gallen Kamp Flame photometer. Concentration of Na and K in the saliva of the experimental animals were not comparable as some of the animals drank water just before sample collection causing dilution of the Saliva.

In order to avoid the effect of this dilution, the molar ratio of Na and K was used for discussion.

Statistical analysis

Analysis of variance (ANOVA) for a 4 x 4 Latin square was used to statistically analyze the results except rumen pH and ammonia nitrogen for which ANOVA for replicated Latin square was used where row (periods) and columns (animals) are not nested.

RESULTS AND DISCUSSION

The chemical composition of the lick block used in the study is given in Table 1.

Dry matter intake, dry matter digestibility, digestible dry matter intake of straw and intake of lick block are presented in Table 2. As a result of urea molasses lick supplementation straw dry matter intake increased from 2.09 - 2.42 kg/100 kg BW ($P < 0.05$). This is in agreement with the results of the past work and contrary to Vincent Sewalt (1985).

However, urea ammonia treatment and the interaction between urea ammonia treatment and supplementation of urea molasses lick showed no effect on intake. The digestibility values obtained for treated straw (47.27%0 was significantly higher ($P < 0.05$) than all other treatments. There was also no difference between the unsupplemented and supplemented groups. (47.19 and 47.38%). Urea molasses supplementation showed no effect on digestibility of either untreated or urea treated rice straw.

Urea ammonia treated rice straw supplemented with molasses lick gave the highest digestible dry matter intake (1.16 kg/100 kg BW) compared to other treatments ($P < 0.05$). Presence of interaction between urea ammonia treatment and lick block supplementation is the main reason for this result. The amount of crude protein or NPN intake may be the limiting factor of intake. In treated straw supplemented with lick block, the intake of crude protein or NPN was comparatively high (310 g). This fact was proven again by the fact that the second and third highest intake of digestible dry matter were observed with treated and untreated straw supplemented with lick block respectively. However, intake of block lick was significantly ($P < 0.05$) higher with the untreated straw than with the treated straw (154.84 vs 82.25 g/100 kg

Table 1. Composition of the urea molasses lick used and straw used in the experiment.

	Lick block	STRAW	
		US	TS
Dry matter	93.19	89.87	56.73
Ash (%)	28.16	17.63	17.83
CP (%)	56.08	5.60	10.80
NH_3 (%)	8.97	–	–
Na mg/g	39.26	0.50	0.49
K mg/g	17.46	9.42	10.00
P mg/g	7.07	0.81	0.76
Mg mg/g	1.30	1.20	1.19
Ca mg/g	40.97	–	–
Co mg/g	9.95	–	–
Cu mg/g	71.29	2.00	2.20
Zn mg/g	206.50	35.00	34.00
Fe mg/g	25.58	280.00	275.00
Mn mg/g	177.63	100.00	101.00

Table 2. Effect of urea ammonia treatment and lick block supplementation on intake and digestibility of rice straw.

Particulars	Untreated straw (US)		Treated straw (TS)		US Vs TS	Without lick Vs With lick
	Without lick	With lick	Without lick	With lick		
Dry matter intake (kg/100 kg BW)	2.08 (0.19)	2.39 (0.10)	2.09 (0.18)	2.44 (0.05)	NS	*
Dry matter digestibility (%)	44.70 (1.04)	40.14 (1.18)	47.19 (1.04)	47.38 (1.22)	**	NS
Digestible dry matter[1] intake (kg/100 kg BW)	0.93[a] (0.12)	0.95[a] (0.04)	0.99[a] (0.09)	1.16[b] (0.11)	**	*
Intake of lick block[2] (g/100 kg BW)	-	154.84[a]	-	82.25[b]		
Intake of CP (g)	120	220	230	310		

[1] Dissimilar superscripts within a row is significantly different ($P < 0.005$)
[2] Calculated by regression analysis
NS = not significant * = $P < 0.05$ ** = $P < 0.01$
Values within parenthesis are standard errors

BW). Although, this pattern is similar to that was found in the previous experiment, there is a considerable reduction in the intake of untreated straw, while treated straw showed an increase. This difference may be due to initial quality of rice straw.

Data on rumen pH and NH_3-N are presented in Table 3. Although the variation in rumen pH was small, statistical analysis show significant difference between untreated straw and treated straw diets and also between with and without supplements. This may be mainly due to the large number of samples used.

Rumen NH_3-N (mg/100 ml) increased from 8.66 to 11.44 ($P<0.01$) by urea ammonia treatment, while the maximum reached was (11.58) with urea molasses lick supplementation. Also, the value of 11.58 for urea treated straw supplemented with lick block was significantly higher ($P<0.05$) than values of all other treatments. Kunju (1986) reported a rumen NH_3-N content of 112 – 195 mg/lit.

The mineral status of the rumen fluid samples is presented in Table 4. Among the mineral analyzed only the potential availability of Ca (mg/dl) and Fe (mg/ml) increased significantly due to urea treatment ($P<0.01$).

Other minerals like Mg (mg/dl) as well as Zn and Cu (mg/dl) remain unchanged due to treatment. None of these mineral levels were affected by supplementation with urea molasses lick.

As regards the haematological parameters, supplementation of lick block show no effect on serum protein, while urea ammonia treatment decreased from 8.04 – 7.49 g/dl ($P=0.05$) (Table 5). In all cases the level of serum protein was found to be normal. The haemoglobin content of blood is not affected by either urea ammonia treatment or supplementation with urea molasses lick

Supplementation of lick blood reduced ($P<0.05$) the numbers of Red blood cells from 8.03 – 6.77 (10^6/cmm). Whereas urea treatment had no effect. Also, PCV (%) was not affected by any of the treatment studied. Supplementation of urea , molasses lick significantly increased ($P<0.05$) the mean corpuscular volume (MCV) by 17.73%. Urea ammonia treatment had no effect on MCV. However, mean corpuscular haemoglobin concentration (MCHC) was not affected by any of the

Table 3. Effect of urea ammonia treatment and lick block supplementation on rumen pH and ammonia levels.

Particulars	Untreated straw (US)		Treated straw (TS)		US Vs TS	Without lick Vs with lick
	Without lick	With lick	Without lick	With lick		
Rumen pH[1]	7.00[d] (0.11)	6.94[b] (0.02)	6.96[c] (0.06)	6.90[a] (0.09)	***	***
Rumen NH_3-N	7.06[a] (1.43)	10.26[b] (1.08)	11.30[c] (1.39)	11.58[d] (2.73)	*	*

[1] Dissimilar superscripts within a row is significantly different (P 0.05)

* = P < 0.05 *** = P < 0.005

Values within parenthesis are standard errors.

Table 4. Effect of urea ammonia treatment and supplementation of lick block on mineral content or rumen fluid.

Minerals	Untreated straw (US)		Treated straw (TS)		US Vs TS	Without lick Vs with lick
	Without lick	With lick	Without lick	With lick		
Ca (mg/dl)[1]	6.40[a] (0.58)	7.17[ab] (0.54)	8.40[b] (0.28)	8.27[b] (0.26)	**	NS
Mg (mg/dl)	3.40 (0.52)	4.03 (1.30)	3.53 (0.30)	3.65 (0.30)	NS	NS
Fe (µg/ml)	6.17 (0.58)	6.99 (1.22)	9.84 (1.27)	9.86 (2.12)	*	NS
Zn (µg/ml)	0.49 (0.06)	0.58 (0.13)	0.73 (0.45)	0.69 (0.17)	NS	NS
Cu (µg/ml)	0.10 (0.01)	0.12 (0.02)	0.13 (0.02)	0.13 (0.02)	NS	NS

[1] Dissimilar superscripts within a row is significantly different ($P < 0.01$)
* = $P < 0.05$ ** = $P < 0.01$
Values within parenthesis are standard errors.

Table 5. Effect of urea ammonia treatment and supplemented of lick block on haematological parameters.

Particulars	Untreated straw (US)		Treated straw (TS)		US Vs TS	Without lick Vs with lick
	Without lick	With lick	Without lick	With lick		
Serum protein (g/dl)	8.05 (0.34)	8.05 (0.07)	7.58 (0.19)	7.40 (0.33)	*	NS
Haemoglobin (g/dl)	11.70 (0.42)	11.49 (0.26)	11.32 (0.51)	11.53 (1.12)	NS	NS
Red blood cell count[1] (10^6/cmm)	7.97[a] (0.21)	6.81[b] (1.22)	8.09[a] (1.27)	6.72[b] (2.12)	NS	*
PCV (%)	39.13 (0.82)	37.69 (0.42)	38.75 (2.32)	39.61 (1.96)	NS	NS
Mean corpuscular volume (MCV) (fl)	49.09 (0.01)	55.35 (0.02)	47.89 (0.02)	58.94 (0.02)	NS	NS
Mean corpuscular haemoglobin concentration (g/dl)	29.90	30.49	29.21	29.11	NS	NS

[1] Dissimilar superscripts within a row is significantly different ($P < 0.05$)

* = $P < 0.05$ Values within parenthesis are standard errors

treatments. It is of interest to note that both MCV and MHCV values are within the accepted ranges of 40 - 60 fl and 26 - 34 (g/dl) respectively. Due to lack of data in literature comparisons or conclusions cannot be made on the above parameters.

The P level in blood plasma is marginal and lower in all cases compared to the normal values of 4 - 9 mg/dl (Table 6). However, lick blood supplementation increased ($P<0.05$) the P level from sub marginal level of 3.84 mg/dl to marginal level (4.96 mg/dl). This suggests that the availability of P to animal ins increased due to supplementation with lick blood. This effect may be due to the incorporation of 'P' in the block. Level of mg found to be subnormal in all the animal and was not affected by any treatments, Ca level is marginal and followed the same pattern as mg.

Fe was within the normal level and was increased by urea ammonia treatment. Supplementation with lick block caused no changes. Laos, Zn and Cu levels were found to be normal in the plasma of all animals and was not altered by any of them treatments.

Urea molasses lick contains higher amount of sodium chloride. As such, a considerable change in the molar ratio of Na:K was expected in the saliva of the animals fed rice straw supplemented with lick block. The results of this study failed to support this expectation (Table 6). The general question of whether straw feeding increases the K content in the blood could be answered only by including a group of animals which are not fed on straw.

CONCLUSION AN RECOMMENDATION

Supplementation of untreated straw with urea molasses lick showed no positive response on the intake of digestible dry matter, whereas better performances was achieved with urea ammonia treated straw. Also, animals fed urea ammonia treated straw performed (on intake and digestibility) better than those fed untreated straw supplemented with lick block. Urea treatment increased the Ca and Fe levels in the rumen fluid, blood Fe level and reduced serum protein. Supplementation with lick block raised the P level in the plasma. On the other hand, number of red blood cells reduced by lick block supplementation.

Table 6. Effect of urea ammonia treatment and supplementation of lick block on mineral content of blood plasma and molar ratio of Na and K in Saliva.

Particulars	Untreated straw (US)		Treated straw (TS)		US Vs TS	Without lick Vs with lick
	Without lick	With lick	Without lick	With lick		
Blood Minerals:						
P (mg/dl)	3.84 (0.35)	4.96 (0.19)	3.74 (0.41)	3.96 (0.41)	NS	***
Mg (mg/dl)	1.76 (0.13)	1.95 (0.10)	1.97 (0.03)	1.93 (0.07)	NS	NS
Ca (mg/dl)	8.57 (0.11)	9.36 (0.40)	8.86 (0.16)	8.60 (0.07)	NS	NS
Fe (µg/ml)	100.58 (16.79)	108.62 (10.23)	127.73 (18.59)	118.18 (10.24)	**	NS
Zn (µg/ml)	120.88 (9.60)	117.98 (18.69)	112.43 (10.89)	90.11 (13.35)	NS	NS
Cu (µg/ml)	76.18 (9.88)	78.67 (10.27)	69.99 (9.26)	66.69 (10.94)	NS	NS
Molar ratio of K : Na in the saliva	1.59 (0.41)	3.19 (0.33)	2.19 (0.93)	2.66 (0.76)	NS	NS

** = P < 0.01 *** = P < 0.005
Values within parenthesis are standard errors

Finally, when considering all the positive and negative effects of supplementation and ammonia treatment, there is no clear indication to whom that supplementation of urea, molasses lick is superior to urea ammonia treatment. The increase in the P level in blood plasma due to lick block could be achieved by mineral supplementation or by feeding a P rich concentrate such as rice bran. The MCV of animal fed without urea molasses lick found within the acceptable range. An increase of 17.73% within the normal range by means of supplementing urea molasses lick will not give any favourable effect to animals.

Therefore, the results of this study indicate that there is no clear advantage in using lick blocks over urea treatment.

ACKNOWLEDGEMENTS

The financial assistant provided by the straw utilization project and Fibrous Feed Utilization Project are kindly acknowledged.

REFERENCES

Dixon, R.M. (1984). Effect of various levels of molasses supplementation on intake of mature Pennissetum perpureum Forage by grazing cattle. Tropical Animal Production. 9: 30 – 34.

Kunju, P.J. (1986). Urea molasses lick in feed supplement for ruminant ration. In: Rice straw and related feeds in ruminant rations. (Ed.) M.N.M. Ibrahim and J.B. Schiene. Straw utilization project. Publication No. 2, Kandy, Sri Lanka. PP: 261 – 274.

James, Band Theron, O.R. (1973). Liquid molasses urea or Biuret (NPV) feed supplements for beef cattle: Wintering performance. Ruminal differences and feeding patterns. JOurnal of Animal Science, Vol. 37, No. 2. pp: 593 – 598.

Ranawana, S.S.E. (1985). Supplementation of straw based ration with minerals. In: Potential of rice straw in ruminant feeding – Research and field application (Eds). M.N.M. Ibrahim, J.B. Schere and J.A. de S. Siriwardena. Straw utilization project. Publication No. 1, Peradeniya, Sri Lanka. pp: 118 – 137.

Vincent Sewalt (1985). Lick block supplementation: Effect on intake and digestibility of straw based diets for growing Salival bulls and heefer. M.Sc. thesis. Department of Tropical Animal Production, University of Wagenengan, the Netherland. pp: 35.