UREA AS A PROTEIN EXTENDER IN FATTENING RATION FOR SHEEP

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The effect of different levels of urea on growth and digestibility of various nutrients of the mixed rations for fattening sheep was investigated. The animals fed on ration containing 2.0 per cent urea were significantly lighter than those fed rations containing 0, 0.5, 1.0, and 1.5 per cent urea. Better weight gain was observed with lambs fed rations containing 1.5 per cent urea. Non-significant differences in feed consumption, digestibility of dry matter, crude protein, ether extract, crude fibre and nitrogen free extract were observed among the experimental rations containing varying levels of urea. The animals fed rations containing 2 per cent urea had significantly poor feed efficiency as compared to those fed rations without urea. Non-significant differences in feed efficiency were noted in lambs fed rations containing 0, 0.5, 1.0 and 1.5 per cent urea. However, ration containing 1.5 per cent urea proved to be the most efficient in feed utilization among urea containing rations. There was a persistent improvement in the retention of nitrogen with the increasing level of urea up to 1.5 per cent but it fell as the percentage of added urea exceeded the aforementioned level. The results of the study indicate that urea can be used safely in sheep fattening rations up to 1.5 per cent, contributing 30 per cent of the total nitrogen of ration.

INTRODUCTION

Protein is the most important component of the livestock ration. Protein rich feeds are generally most expensive than those which are relatively low in protein but higher in carbohydrates and fats. Many investigators have shown that rumen microbes can convert urea into protein for their own body cells. This protein is further hydrolysed during digestion of the microbes and is thus made available for the host animal (Morrison, 1959). This mechanism helps ruminants in the conversion of non-protein nitrogenous substances into better quality protein. The use of urea, being a cheaper ingredients on nitrogen equivalent basis (N $\times$6.25), can reduce the cost of ration and can also replace partly the costly protein source like oil cakes. The present investigation was undertaken (*i*) to study the effect of urea feeding on growth rate in fattening sheep, (*ii*) to determine the safe level at which urea can be substituted for cotton seed cake, (*iii*) to investigate an optimum level of urea in rations of lambs

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raised for mutton purpose, and (*iv*) to study the adverse effect of urea, if any, on the digestibility of the various constituents of mixed rations.

REVIEW OF LITERATURE

Johnson *et al.* (1942) observed that ration containing 16-17 per cent protein equivalent, of which 65 per cent was provided by urea, could not satisfy the nitrogen requirement of growing lambs. They further reported that raising the protein level of low protein ration to 12 per cent through the addition of urea, affected retention of nitrogen which could not be improved by further addition of urea.

Willman *et al.* (1947) conducted feed trials with 84 lambs to compare the feeding value of urea with linseed meal. They obtained an average daily gain of 0.26 and 0.32 pound with urea containing ration and linseed meal supplemented ration respectively. The lambs fed ration in which all the linseed meal was replaced by urea showed poor appetite. Ellis and Pfander (1958) reported that the digestibility of organic matter, cellulose, nitrogen free extract, nitrogen and total digestible nutrients was significantly influenced by increasing the level of nitrogen in the semi purified ration of lambs. No improvement in the digestibility of nitrogen was noted by increasing the nitrogen contents of ration from 2.05 to 2.45 per cent. Morrison (1959) stated that high level of urea in the concentrate mixture might make it unpalatable and animals might be poisoned if they consumed more than a certain amount of urea. It was concluded that not more than 2-3 per cent of urea should be included in the total concentrates fed, otherwise the palatability might be decreased. He is also of the view that conversion of urea into protein is not efficient when the ration does not have a readily available supply of energy for bacteria, or when urea is added to a mixture that is already fairly high in protein. Szabe *et al.* (1965) in a trial with 4 wethers concluded that the amount of urea per head per day could be gradually increased from 15-40 grams without the risk of poisoning. Higher level of urea, viz., more than 20 grams, although safe, was not advised because of its cumulative effect on liver.

MATERIAL AND METHODS

Twenty young male *Lohi* lambs of approximately same age, size and weight were used in this study. The experimental lambs were divided into four groups (blocks) of five lambs each according to their initial body weight. The basal ration consisted of cotton seed cakes (undecorticated), wheat *Bhoosa* and cane molasses. Five experimental rations including control containing varying levels of urea, viz, 0, 0.5, 1.0, 1.5 and 2.0 per cent (Table 1) were fed to the lambs *ad libitum* for a period of 91 days. In addition to experimental ration,

each lamb received 1/2 pound of berseem hay to meet the carotene requirements. Fresh and clean water was made available all the times to each lamb. Records of initial body weight, weekly body weight, final body weight, daily feed consumption, total amount of urine excreted and faeces voided during 24 hours of the last week of the study were maintained. The composite urine samples were analysed for their nitrogen content. The analysis of the representative dried, ground and thoroughly mixed samples of rations and faeces for dry matter, crude protein, ether extract, crude fibre, nitrogen free extract and ash was carried out according to AOAC (1960) methods. The data collected were subjected to statistical analysis using analysis of variance (Snedecor, 1959). The comparison of mean weight gain, feed efficiency and nitrogen retention were made by Duncan's Multiple Range Test (Duncan, 1955).

TABLE 1. *Experimental Rations*

Ingredients	RATIONS				
	A lbs	B lbs	C lbs	D lbs	E lbs
Cotton seed cake (undecorticated)	40.0	39.5	39.0	38.5	38.0
Urea	0.0	0.5	1.0	1.5	2.0
Molasses (cane)	30.0	30.0	30.0	30.0	30.0
Wheat *bhoosa*	30.0	30.0	30.0	30.0	30.0
Salt (Common)	0.2	0.2	0.2	0.2	0.2
Total	100.2	100.2	100.2	100.2	100.2
Dry matter (per cent)	87.17	86.69	86.24	85.78	86.69
Crude protein (per cent)	9.29	10.48	11.69	12.90	14.11
Total Digestible Nutrients (per cent	68.22	62.85	62.55.	62.13	62.85
Calcium (per cent)	0.490	0.487	0.486	0.484	0.483
Phosphorus (per cent)	0.648	0.643	0.636	0.630.	0.624

RESULTS AND DISCUSSION

The summary of data on weight gain, feed consumption and feed efficiency of lambs fed various experimental rations for a period of 91 days is given in Table 2.

TABLE 2. *Summary of Growth and Feed Efficiency Data*

Rations	A	B	C	D	E
Number of Animals	4	4	4	4	4
Days on experiment	91	91	91	91	91
Average initial weight (lbs.)	43.81	43.75	43.06	55.06	42.81
Average final weight (lbs.)	65.12	63.38	61.91	64.12	51.45
Total weight gain (lbs.)	21.31	19.63	18.85	20.06	8.64
Average daily weight gain (lbs.)	.234	.216	.207	.220	.096
Average feed consumed per animal (lbs)	229.87	229.17	229.14	224.10	195.56
Average daily feed consumed per animal (lbs.)	2.53	2.52	2.52	2.46	2.15
Average amount of feed required per lbs. of weight gain	10.78	12.17	12.17	11.17	22.64

The lambs fed ration E containing 2.0 per cent urea were significantly ($P < 0.05$) lighter than those fed rations A, B, C, and D containing 0, 0.5, 1.0 and 1.5 per cent urea. The animals on ration A containing no urea were heavier than those on other rations and showed a maximum weight gain. But non-significant differences in weight gain were observed among lambs fed rations A, B, C and D. However, among the urea containing rations better weight gain was noted with animals fed ration D containing 1.5 per cent urea ration. As is evident from the results, ration D containing 1.5 per cent urea (with a protein equivalent of 12.90 per cent) apparently gave better weight gain as compared to other rations, *viz.*, B, containing 0.5 per cent urea (with protein equivalent of 11.69 per cent) and ration E containing 2.0 per cent urea with protein equivalent of 14.11 per cent). The results are in line with those reported by Willman *et al.* (1947), who obtained an average daily gain of 0.26 pound with urea containing ration (12.3 per cent protein equivalent). The ration E containing 2.0 per cent urea, being highest in crude protein, gave lower weight gain as compared to rations B, C and D. It may be attributed to a higher excretion and loss of nitrogen in the urine of lambs fed that ration. This is substantiated by the statement of Johnson *et al.* (1942), who observed

that raising the protein level of a low protein ration to 11 per cent through the addition of urea affected retention of nitrogen which could not be improved by further addition of urea.

Feed Consumption

Among the animals fed rations containing varying levels of urea, the lambs fed rations B and C containing 0.5 and 1.0 per cent urea had the highest feed consumption followed by those consuming ration D and E containing 1.5 per cent and 2.0 per cent urea. But non-significant differences in feed consumption were observed among the rations containing varying level of urea. The lambs fed ration A with no added urea had apparently better feed consumption than those consuming ration E containing 2.0 per cent urea, but the statistical analysis did not reveal any significant difference. The lower feed consumption noted with ration E may be due to its poor acceptability on account of higher level of urea. The findings are in agreement with those reported by Morrison (1959), who stated that too large an amount of urea in the concentrate mixture makes it unpalatable.

Feed Efficiency

The lambs fed ration E had significantly ($P<0.05$) poor feed efficiency as compared to those fed rations A, B, C and D. Non-significant differences in feed efficiency were noted in animals fed rations A, B, C and D. However, ration D proved to be most efficient in feed utilization among urea containing rations.

Digestibility of various nutrients of the mixed rations

The summary of data on the digestibility of various nutrients of the experimental rations is given in Table 3.

TABLE 3.—*Digestibility Coefficient Data*

Rations	Dry matter	Crude protein	Ether Extract	Crude Fibre	Nitrogen-free extract
A	39.80	77.26	87.63	72.89	64.83
B	39.76	75.65	87.31	61.76	75.51
C	39.23	73.23	86.64	64.53	59.92
D	40.69	74.02	81.32	66.76	68.73
E	46.74	75.88	86.75	70.84	63.04

Non-significant differences in digestibility of dry matter, crude protein, ether extract, crude fibre and nitrogen free extract were observed among experimental rations containing varying level of urea. There was a trend towards the improvement of the digestibility of crude fibre with the increasing levels of added urea. The results are in agreement with those of Ellis and Pfander (1958), who observed that increasing the nitrogen level in the ration significantly influenced the digestibility of cellulose.

Nitrogen Balance

The percentage of nitrogen retained by lambs fed rations A, B, C, D and E is shown in Table 4.

TABLE 4.—*Nitrogen Balance Data*

Rations	Urea per cent	Nitrogen retained per cent
A	0.0	28.15
B	0.5	43.29
C	1.0	44.68
D	1.5	51.32
E	2.0	32.77

The animals fed ration A with no added urea retained significantly ($P<0.05$) lower percentage of nitrogen as compared to those fed rations C and D. Non-significant differences were observed in the percentage of nitrogen retained by animals fed rations A, B, and E. Significantly ($P<0.05$) higher percentage of nitrogen was retained by lambs fed ration D as compared to those on ration E. However, non-significant differences were observed in percentage of nitrogen retained by the animals fed rations B, C and D. There was a persistent improvement in the retention of nitrogen with increasing levels of urea up to 1.5 per cent. Lesser amount of nitrogen was retained by lambs fed ration containing higher level of urea (2.0 per cent). The findings are in agreement with those reported by Johnson *et al.* (1942), who observed that rations containing 16-17 per cent protein equivalent of which 65 per cent was provided by urea could not satisfy the nitrogen requirement of growing lambs. They further reported that raising the protein level of a low protein ration to 12 per cent through the addition of urea affected retention of nitrogen which could not be improved by further addition of urea. The results of this study

show that best retention of nitrogen was obtained with ration D containing 1.5 per cent urea of which 30.4 per cent was provided by urea.

LITERATURE CITED

A. O. A. C. 1960. Official Methods of Analysis of Association of Official Agricultural Chemists (9th Ed.) Washington 4. D. C.

Duncan, A. B. 1955. Multiple Range and Multiple F. Test. *Biometrics* 11: 1.

Ellis, W. C., and W. H. Pfander, 1958. The influence of varied cellulose nitrogen levels upon ration digestibility and nitrogen balance of lambs fed semipurified ration. *Jour. Nut.* **65** : 235.

Johnson, B. C., T. S. Hamilton, H. H. Mitchell, and W. B. Robinson. 1942. The relative efficiency of the urea as a protein substitute in ration of ruminants. *Jour. Ani. Sci.* **1** : 236.

Morrison, F. B. 1959. *Feeds and Feeding* (22nd Ed.) Morrison Publishing Co., Clinton, Iowa.

Snedecor, G. W. 1959. *Statistical Methods*. The Iowa State College Press, Ames., Iowa.

Szabe, I., U. Jellegen, and K. Kisorletek. 1965. Farm trials with urea as a feed. *Nut. Abst. and Rev.* **35** : 1163.

Willman, J. P., F. B., Morrison, and E. W. Klosterman. 1947. Lamb feeding experiment. *Cornell. Agr. Exp. Sta. Bull.* **834** : 62.