Adaptation to Biuret as an NPN Source and as influenced by the Level of Concentrate and Level of Biuret in the Ration in the Ration

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Story in Brief

Utilization of biuret as an NPN source requires the development of the ability of rumen microorganisms to degrade biuret to ammonia. Although this adaptation time may involve several weeks on high roughage rations, the inclusion of a small amount of dietary concentrate has been shown to decrease the time required for maximum adaptation to 1-2 weeks.

Rations containing 20 percent ground corn supported the most rapid rate of adaptation when compared to higher levels of concentrate. When biuret provided less than 15 percent to 20 percent of the digestible protein, the biuretolytic activity of rumen contents was significantly reduced. Thus, there appears to be a minimum level of exposure to biuret as an NPN source to promote maximum utilization.

Introduction

A prime difficulty in the use of biuret as a supplemental protein source for roughage fed ruminants has been the lengthy adaptation period required by these animals before they are effectively able to utilize biuret. Experiments conducted at this university indicate that biuret must be fed for a period of two to five weeks before the rumen microorganisms can adequately degrade biuret to NH_3.

Additional studies, demonstrated that a small amount of concentrate enhanced the rate of adaptation. The following studies were undertaken to determine what effect the level of dietary concentrate has on the rate of adaptation and extent of biuret utilization by the rumen microorganisms. Also, the effect of the level of biuret in the ration on rate and extent of adaptation was studied.

Methods and Materials

Trial 1

Eight feeder lambs with permanent rumen cannulas were fed one of four experimental rations (Table 1). The levels of dietary concentrate were regulated by adding either 20, 40, 60 or 80 percent ground corn to

Table 1. Ration Composition for Sheep Fed Biuret and Various Levels of Concentrate. (Trials 1 and 2)

Ingredient (%)	% Composition, air dry basis Trial 1				Trial 2[1]	
	1	2	3	4	2	3
Ground corn	20.0	40.0	60.0	80.0	21.2	22.3
Corn starch					18.8	37.7
Cottonseed hulls	74.9	55.4	36.0	16.6	55.4	36.0
Molasses	5.0	5.0	5.0	5.0	5.0	5.0
Biuret	2.13	1.55	0.98	0.40	2.13	2.13
Limestone	0.00	0.06	0.18	0.31	0.10	0.12
Dicalcium phosphate	0.60	0.53	0.46	0.37	0.52	0.61

[1] Trial 2 contained a ration identical to ration 1, trial 1.

the complete mixed rations. The level of biuret was adjusted such that all rations were equal in digestible protein content.

Rumen contents were collected from each animal on days 0, 2, 4, 7, 10 and 14 for laboratory analysis. The ability of the rumen microorganisms to degrade biuret to ammonia (biuretolytic activity) was determined by incubating the rumen contents with a biuret solution at 39° C and measuring the disappearance of biuret over a 24 hour period.

Trial 2

Three rations containing either 20, 40 or 60 percent concentrate (Table 1) were fed to nine rumen cannulated sheep. However, in this trial the level of dietary concentrate was regulated by adding corn starch over and above the 20 percent ground corn level. In this manner researchers were able to maintain rations that were equal in both digestible protein and biuret levels, while changing the level of dietary concentrate consumed.

Rumen contents were withdrawn from each animal on days 0, 2, 4, 7, 10 and 14 and weekly thereafter for the 35 day test period. The biuretolytic activity of each rumen sample was measured as described above. The disappearance of biuret was measured for each sample and is reported as the average value for those animals on the same ration.

Trial 3

In this trial, the levels of concentrate and roughage were held reasonably constant while the proportion of total nitrogen present as biuret was 20, 50 or 80 percent. The level of concentrate was between 10 and 16 percent and cottonseed hulls provided the roughage source. Nine rumen cannulated sheep were divided into three groups which were fed the rations

shown in Table 2. Biuretolytic activity in the rumen contents was determined on days 0, 3, 5, 7, 10, 14, 21, 28 and 35 after initiation of the trial.

Results and Discussion

Trial 1

The biuretolytic activities of the rumen contents for those animals in the first trial are reported in Figure 1. The rate of adaptation was

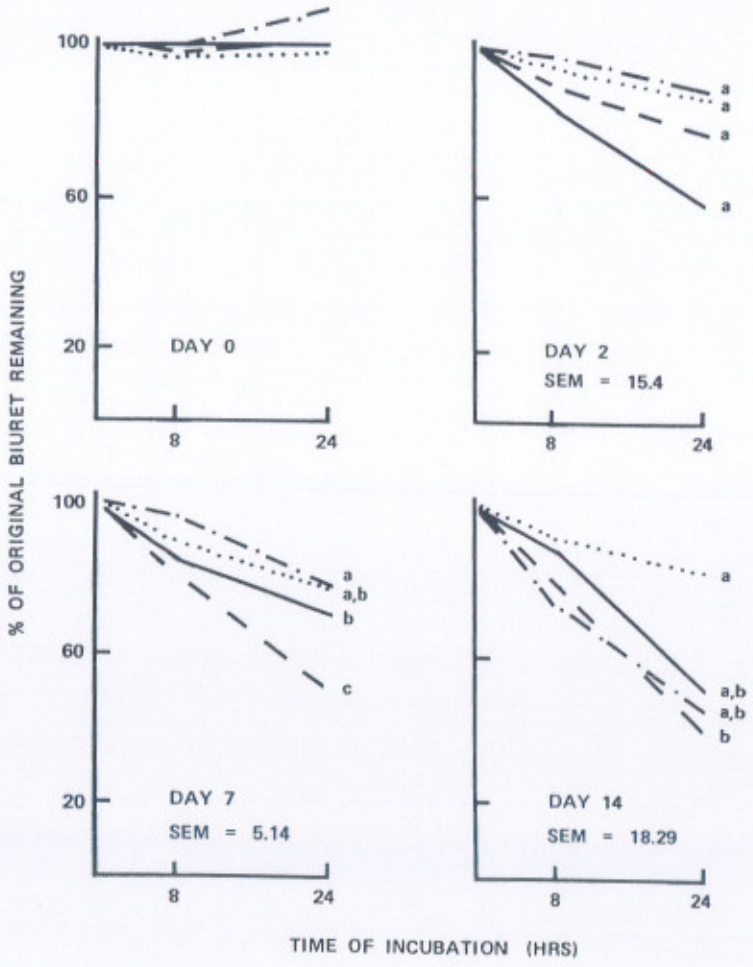

Figure 1. Biuret disappearance in rumen contents from sheep fed biuret and 20% (___), 40% (_ _), 60% (_._) or 80% (. . . .) ground corn. (Trial 1)

Table 2. Composition of Experimental Rations Fed to Sheep in Trial 3.

Ingredient	% Composition, air dry basis		
	1	2	3
Ground corn	6.53	10.91	12.92
Soybean meal	9.94	4.76	0.00
Cottonseed hulls	80.00	80.00	82.10
Biuret[1]	0.53	1.33	2.12
$NaSO_4$	0.19	0.48	0.76
Dicalcium phosphate	0.11	0.22	0.39
Limestone	0.12	0.10	0.02
T. M. salt	0.60	0.60	0.60

[1] Biuret provided 20, 50 and 80% of the total nitrogen in rations 1, 2 and 3 respectively.

such that animals on 3 of the 4 diets obtained significant activity within the first 14 days on test. Comparing this to earlier studies clearly indicated that the addition of some readily fermentable carbohydrates greatly stimulated the rate of biuret adaptation within these animals. Some response to biuret feeding was noted for all animals on day 2 and near maximum activity was obtained by day 10 or 14 for three groups of animals.

The sheep receiving either the 20, 40 or 60 percent ground corn rations apparently were better able to adapt to biuret feeding, as indicated by the loss of biuret on day 14 (Figure 1), than were those animals fed the 80 percent ground corn diet. However, it was realized that those sheep on the 80 percent concentrate were receiving less than 15 percent of their protein from biuret. On the other hand, the level of dietary biuret was progressively increased as the level of concentrate was reduced for the animals on the other diets.

To correct for this confounding effect of biuret level and concentrate level a second trial was conducted.

Trial 2

In this experiment the level of biuret was held constant while the increased concentrate fractions were achieved by adding corn starch, free of protein. The results as shown in figure 2 would indicate that, initially the higher levels of concentrate stimulated a more rapid rate of adaptation over the first 4 days on feed. However, by day 7 the situation was reversed and those animals receiving the lowest level of concentrate (20 percent) consistently demonstrated greater biuretolytic activity in their rumen contents.

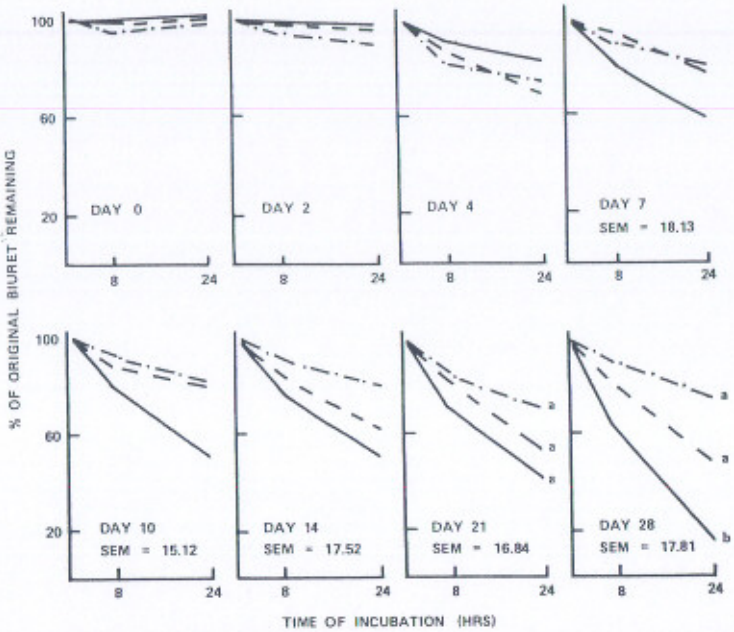

Figure 2. Biuret disappearance in rumen contents from sheep fed biuret and 20% (—), 40% (– –), or 60% (–.–) concentrate rations. (Trial 2)

The extent of biuret hydrolysis was such that by day 28 rumen contents from animals fed the 20 percent concentrate ration degraded 3 to 4 times as much biuret as that from the animals fed 60 percent concentrate and twice that of the 40 percent concentrate group.

Trial 3

In this trial biuretolytic activity began to appear at day 3 but increased slowly and did not appear to reach maximum until day 28 (Figure 3) when biuret constitued 50 or 80 percent of the nitrogen. On the other hand, when biuret was only 20 percent of the nitrogen, nearly maximum biuretolytic activity was achieved by day 7 and following that time, biuretolytic activity in this group was significantly ($P<.05$) less than in the other groups.

For all three trials the rate of adaptation was sufficiently rapid that considerable activity was achieved within the first 10 to 14 days on feed. Maximum activity was not reached until about 28 days, however. This clearly suggests that the rate of adaptation to biuret is stimulated by the

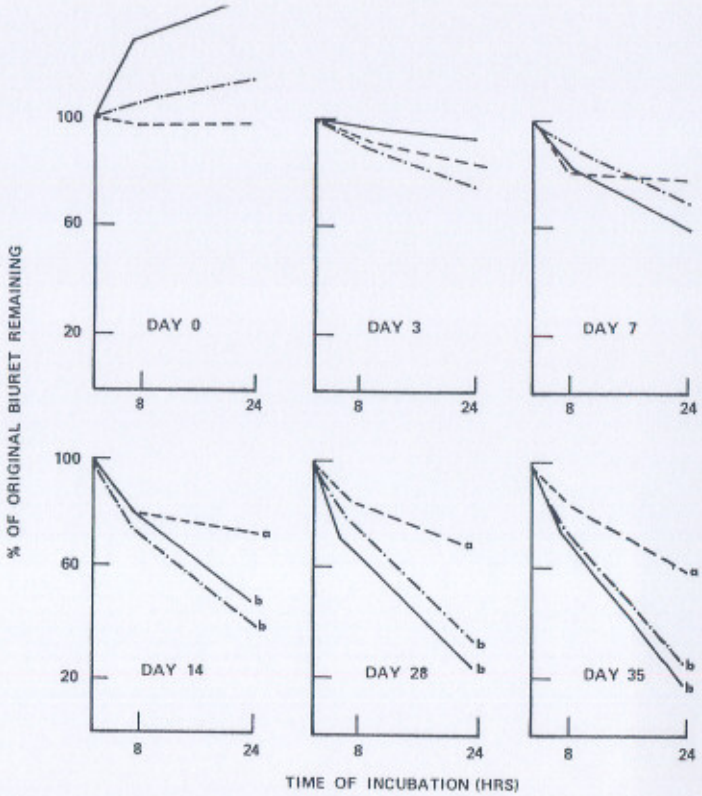

Figure 3. Biuret disappearance in rumen contents from sheep fed rations in which biuret provided 20% (_ _), 50% (_._) or 80% (___) of the total nitrogen. (Trial 3)

feeding of some readily fermentable carbohydrates. The lack of response observed for the 80 percent ground corn diet (trial 1) is presumed to be due to the low level of dietary biuret fed these animals. Trial 3 results support this theory in that biuretolytic activity was much less when biuret was only 20 percent of the total nitrogen.

Presumably, when other sources of nitrogen are present in sufficient quantity, the needs of the microorganisms are met from those sources. The results further suggest that a ration containing 20 percent ground corn (or other starch source) would be adequate for stimulating a rapid rate of adaptation to biuret. Concentrate levels above the 20 percent level substantially reduced the rate and possibly the extent of biuret utilization.