Influence of Periods of Starvation on Blood Ammonia and Plasma Urea Concentrations of Steers Grazing Wheat Pasture

F. P. Horn, G. W. Horn, H. R. Crookshank,
W. Jackson, H. J. Muncrief and R. Osborne

Story in Brief

Steers were starved for 12, 24 or 48 hours in order to simulate the changes in grazing behavior which occurs in stocker cattle on wheat pasture due to the frequent movement of severe weather fronts across the Southern Great Plains. The 48-hour starvation periods resulted in considerable body weight losses which were regained when the cattle were put back on wheat pasture due to rapid forage ingestion. The blood concentrations during the period of rapid forage ingestion were in the range of 0.25 to 0.4 mg/100 ml and indicate that ammonia toxicity *per se* is not a significant cause of deaths in stocker cattle grazed on wheat pasture. Signs of bloat were not observed in any of the cattle during the post-starvation grazing periods.

Introduction

Among the problems causing death losses in cattle grazed on wheat pasture is one known as the stocker syndrome. The results of previous studies (1,2) indicate that the death losses due to the stocker syndrome cannot be attributed to acute mineral imbalances, nitrate toxicity, or clostridial toxins. Based on (1) observations of live stocker cattle that exhibit marked abdominal distension, (2) the relief of the distension by the administration of therapeutic dosages of poloxalene, (3) the fact that some distended live animals which were marked with paint pistols were subsequently found dead, (4) nature of ruminal contents of dead animals, and (5) necropsy lesions indicative of antemorteum bloat, it appears that frothy bloat is a major cause of death in stocker cattle grazed on wheat pasture (1). Another factor that is often mentioned by producers, and which is believed to be related to the death losses of stocker cattle on wheat pasture, is the marked changes in grazing behavior which occurs in these cattle in response to the movement of weather fronts through the area. Since wheat forage undergoes a very

rapid rate of ruminal digestion, a period of little or no grazing followed by a period of very active grazing would be condusive to the bloating of cattle.

A second question that has been raised relates to the fact that wheat forage is high in crude protein with values of 14 to 33.7% of the forage dry matter reported (2). Johnson *et al.* (3) have also reported crude protein values of wheat forage dry matter of 25 to 31% during January to April with 17 to 33% of the nitrogen being in the form of non-protein nitrogen. These data, along with the high ruminal ammonia concentrations and high ruminal pH values of 6.2 to 7.6 (2), have prompted the suggestion that ammonia toxicity is a possible etiological factor in the stocker syndrome. The studies which we report here were conducted to (1) examine the grazing behavior of stocker cattle on wheat pasture, and (2) the possible involvement of marked changes in grazing behavior with the stocker syndrome.

Materials and Methods

Grazing Behavior Studies

During the 1973-74 wheat pasture grazing season, 30 stockers were continuously observed for a 72-hour period in which a severe weather front was forecasted to move through the area, and recordings were made every 15 minutes as to how many were grazing, not grazing, not grazing and seeking shelter, lying down, or drinking water.

Starvation-Refeeding Studies

Twenty-eight acres of triumph winter wheat were established in mid-September, 1974, at the Fort Reno Livestock Experiment Station, and 42 stocker steers were grazed on the area from December 1, 1974 to March 24, 1975. Changes in grazing behavior of stockers, which occurs due to the movement of weather fronts, was simulated by holding the cattle off pasture in a drylot with access to water (starvation) for varying periods of time prior to being put back on wheat pasture (refeeding). Three trials (January 13-17; February 10-14; and March 17-21, 1975) were conducted in which the steers were randomly assigned to 6 experimental groups that consisted of 2 control groups and 4 starvation-refeeding groups. The length of the starvation periods and the time at which starvation was begun for each group of cattle is shown in Table 1. All steers were weighed and blood samples were taken immediately before and after each starvation period, and at 2, 6 and 14 hours after the cattle were put back on wheat pasture. The blood samples were analyzed for blood ammonia and plasma urea concentrations.

Table 1. Experimental Groups for Starvation-Refeeding Studies

Group No.	Hours of fast	Start of fast	No. of stockers
1	0	8 A.M.	7
2	12	8 A.M.	7
3	24	8 A.M.	7
4	48	8 A.M.	7
5	0	8 P.M.	7
6	48	8 P.M.	7

During each trial, forage samples were taken and analyzed for the following: dry matter, crude protein, acid-detergent fiber, acid-detergent lignin, neutral-detergent fiber, ash, silica and *in vitro* dry matter digestibility.

Results and Discussion

Grazing Behavior Studies

The cattle did most of their grazing between 7 a.m. and 12 midnight, and grazed most intensively from 9-10 a.m. and from 8-10 p.m. All of the calves sought shelter immediately before the storm front hit the pasture (5 p.m., 2-20-74), and did not graze again until the weather had cleared (9 a.m., 2-21-74). Once they began to graze again, they grazed very intensively for 6 to 8 hours. About 25% of the calves exhibited marked abdominal distension at 9 hours after the weather had cleared and were believed to be bloated. These studies indicated that self-imposed periods of non-grazing for various periods of time could occur quite frequently in stocker cattle on the Southern Great Plains, and may be an important etiological factor in the stocker syndrome.

Starvation-Refeeding Studies

The chemical composition of the wheat forage samples is shown in Table 2. The average crude protein content was 26.6% of the forage dry matter.

The body weight changes during the 12-, 24-, or 48-hour starvation periods, and after the cattle were put back on wheat pasture are shown in figure 1. The longer starvation periods resulted in marked body weight losses with the 48-hour starvation period effecting body weight losses of 30 and 51 lb for groups 4 and 6, respectively. The body weight changes of the cattle during the 24- and 48-hour starvation periods are indicative of the loss of considerable gastrointestinal tract fill, whereas those during the 14-hour period after the cattle were back on pasture

Table 2. Chemical Composition[1] of Wheat Pasture Forage During Starvation-Refeeding Studies

Item	Trial 1	Trial 2	Trial 3	Avg.
Crude protein	27.1	22.5	30.1	26.6
Acid-detergent fiber	25.6	26.4	25.3	25.8
Acid-detergent lignin	6.6	5.8	6.5	6.3
Neutral-detergent fiber	54.9	58.8	48.2	54.0
Total ash	10.1	10.5	11.9	10.8
Silica	1.9	2.0	3.0	2.3
IVDMD[2]	62.2	76.0	81.5	73.2

[1]Dry matter basis.
[2]*In vitro* dry matter digestibility.

indicate that the cattle consumed substantial amounts of wheat forage. None of the cattle, however, showed any signs of bloat or any other adverse signs.

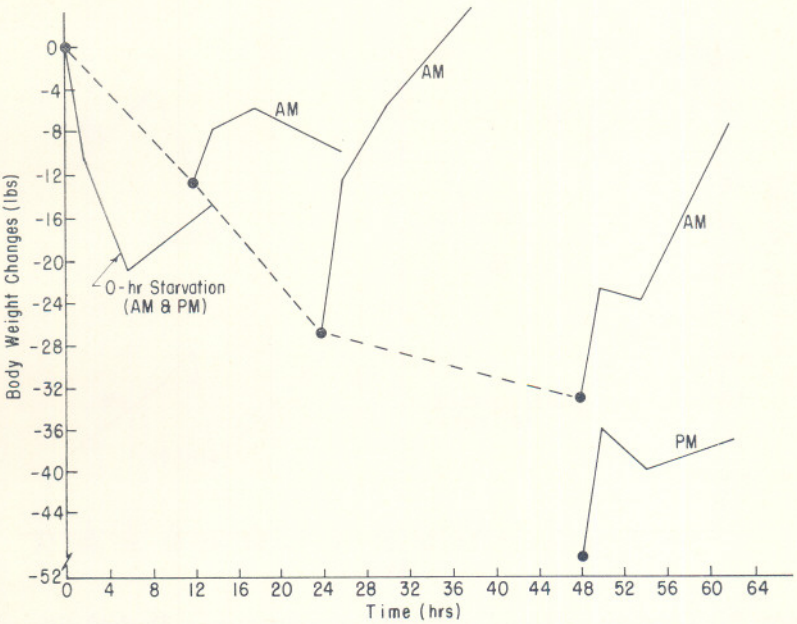

Figure 1. Stocker body weight changes. Dashed line represents the average body weight losses during starvation. Solid lines originating from solid dots denote changes after the cattle were returned to pasture.

The relative changes in the blood ammonia and plasma urea concentrations are shown in figures 2 and 3, respectively. Also shown are the absolute blood ammonia and plasma urea concentrations of the groups of cattle immediately after the starvation periods. The blood ammonia concentrations ranged from approximately 2.5 to 4μg/ml of blood (.25 to .4 mg/100 ml of blood) and were not greatly increased during the post-starvation periods of rapid wheat forage intake. Even though wheat forage is high in protein and non-protein nitrogen, the blood ammonia and plasma urea concentrations indicate that the rate of ruminal ammonia absorption did not exceed the rate at which the liver was capable of converting it to urea, and that ammonia toxicity *per se* is probably not a significant cause of deaths in cattle grazed on wheat pasture. Blood ammonia concentrations have to reach approximately 0.8 mg/100 ml before signs of ammonia toxicity are evident, and approximately 1.5 to 2.0 mg/100 ml in order to result in cattle deaths.

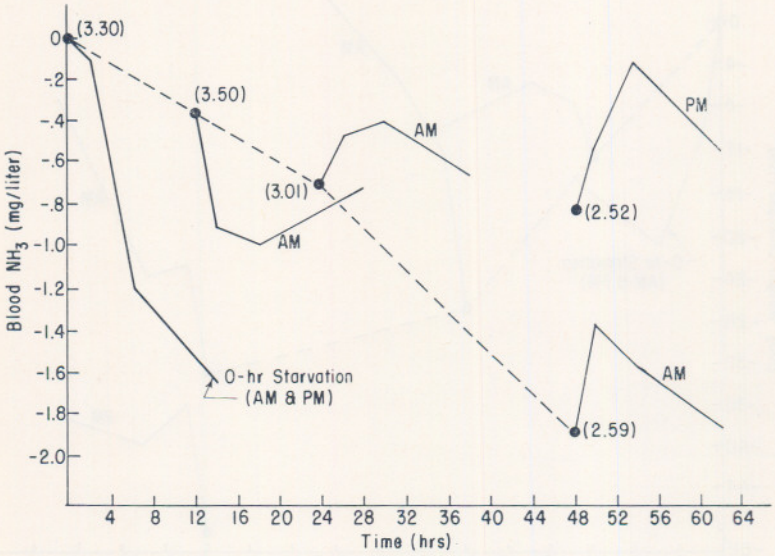

Figure 2. Changes in blood ammonia concentrations. Dashed line represents changes during starvation. Solid lines originating from solid dots denote changes after cattle were returned to pasture. Numbers in parentheses are mean blood ammonia concentrations for each group immediatley after starvation.

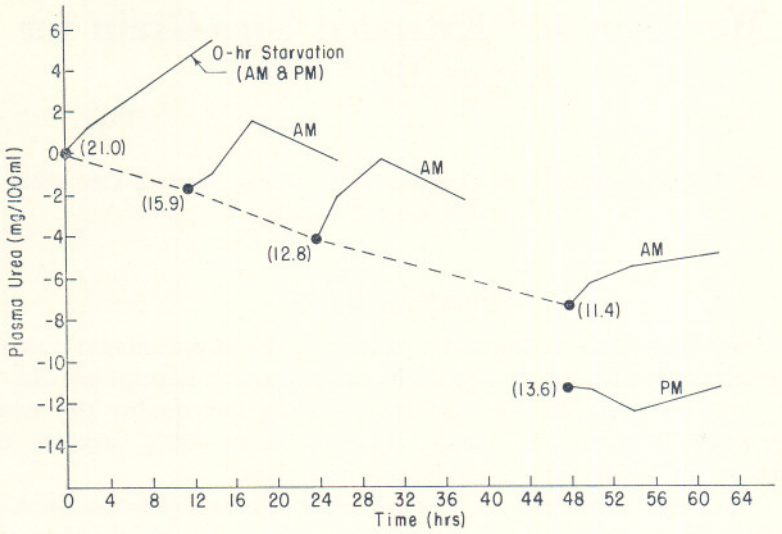

Figure 3. Changes in plasma urea concentrations. Dashed line represents changes during starvation. Solid lines originating from solid dots denote changes after cattle were returned to pasture. Numbers in parentheses are mean plasma urea concentrations for each group immediately after starvation.

Literature Cited

1. Clay, B. R. 1973. Research Report P-690, Okla. Agric. Exper. Sta. p. 8.
2. Horn, F. P. *et al.* 1974. Anical Sciences and Industry Research Report, MP-92. Okla. Agric. Eper. Sta. & U.S.D.A. p. 7.
3. Johnson, R. R. *et al.* 1974. Animal Sciences and Industry Research Report, MP-92. Okla. Agric. Exper. Sta. & U.S.D.A. p. 37.