



FEEDING CULL ONIONS TO LAMBS AND EWES

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ABSTRACT

Cull onions, as by-products of the onion industry, are commonly fed to sheep and cattle in major onion producing areas. Sheep producers can lower feed costs by utilizing cull onions that are unsuitable for human consumption. The objectives of the studies were to determine the effects of feeding cull onions to:
 1) finishing lamb with respect to growth rate, carcass traits, cost analysis, and meat sensory attributes.
 2) pregnant ewes of an exclusive diet with respect to pregnancy rates, lambing percentage, and fleece weight.

Lambs were fed a diet containing 0%, 25%, 50%, 75%, or 100% of the dry matter as cull onions for approximately the last 60 days of the feeding period. The remainder of the diet included a commercial finishing ration. Lambs in all groups received their respective diets at a constant daily rate (3.5% of body weight on an as-fed basis.) At slaughter, carcasses were evaluated for USDA quality and yield grades. A random selection of loin samples from each treatment group were evaluated for shear force determination and sensory panel evaluation. (figure 1)

In the ewe study, a diet consisting entirely of cull onions was fed to pregnant ewes for the last 102 days of gestation. The control ewes were fed an alfalfa and grain diet. Blood samples were taken in regular intervals throughout the trial and analyzed to determine the packed cell volumes (PCV) and the presence of Heinz body anemia. In this study, the ewes rapidly adapted to eating the cull onions and although they all developed a Heinz body hemolytic anemia, they did not appear to be adversely affected when compared to the controls. Compared to control ewes fed an alfalfa and grain diet, the onion-fed ewes had comparable body condition scores and fleece weights. There was no significant difference ($\alpha = 0.05$) in pregnancy or lambing rate, number of lambs born/ewe exposed, or number of lambs born/ewe lambing. Greater numbers of sulfate-reducing bacteria (*Desulfovibrio spp*) and more ruminal hydrogen sulfide were present in onion-fed sheep compared to controls. Although an average 27% reduction in packed cell volume and Heinz body anemia developed in the onion-fed ewes, on the basis of this study it appears that in pregnancy ewes may be fed a pure onion diet with minimal detrimental effects. Adaptation to a pure onion diet may be due to the ability of the sheep's rumen to quickly develop a population of sulfate reducing bacteria that decrease the toxicity of onion disulfides.

Dietary Grp.	Tenderness		Juiciness		Flavor Intensity		Desirability		Overall Palatability	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
0%	6.14	0.41	5.63	0.46	5.53	0.28	5.57	0.27	5.49	0.34
25%	4.31	0.41	5.13	0.46	5.13	0.28	4.99	0.27	4.63	0.34
50%	5.77	0.45	5.76	0.52	5.86	0.31	5.63	0.3	5.7	0.38
75%	5.26	0.45	6.18	0.52	5.61	0.31	5.69	0.3	6.07	0.38
100%	5.57	0.4	5.26	0.5	5.19	0.3	5.39	0.3	5.38	0.3

Sensory measurements based on an 8 point scale: 8 = extremely juicy, extremely tender, extremely intense lamb flavor, extremely desirable lamb flavor, and extremely desirable overall palatability; 1 = extremely dry, extremely tough, extremely bland, extremely undesirable lamb flavor, and extremely undesirable overall palatability. *figure 1

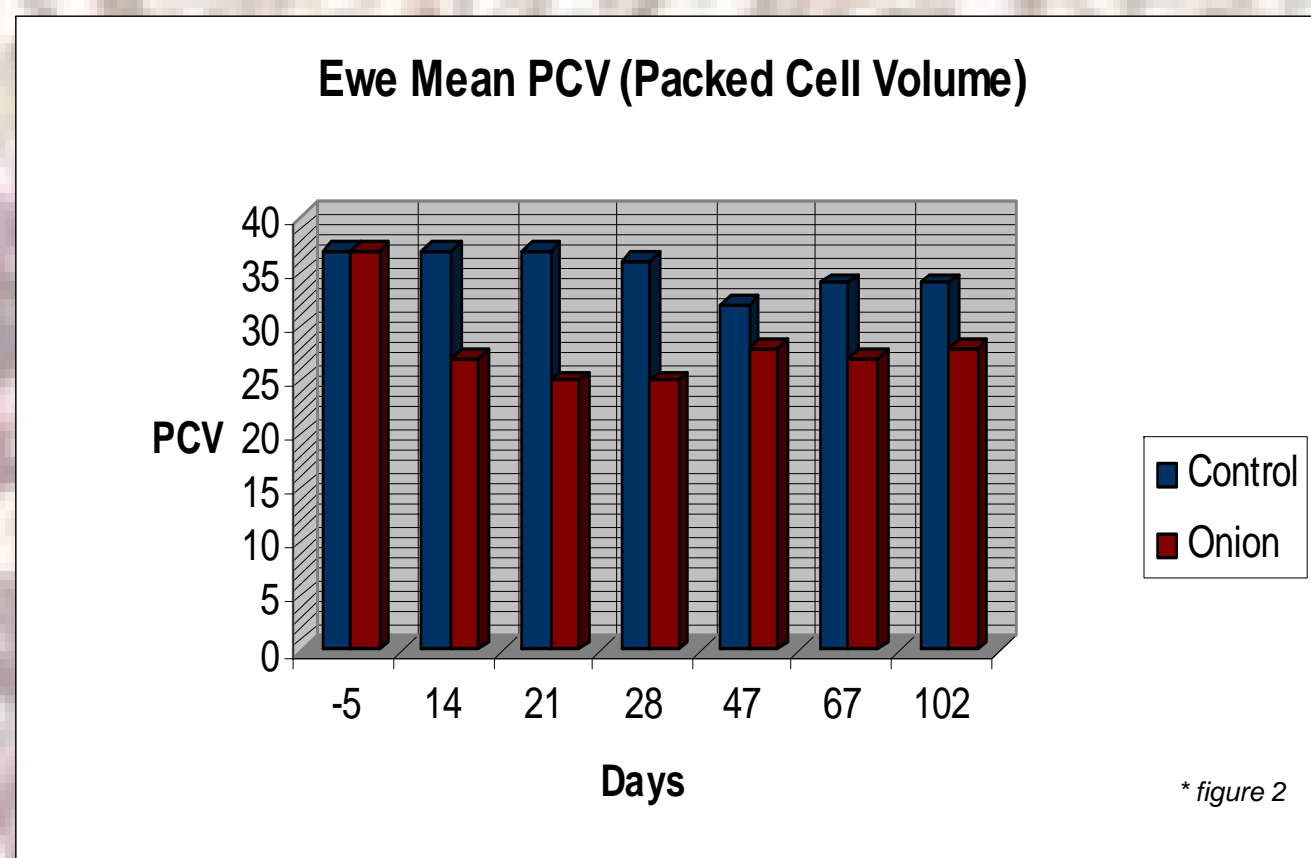
MATERIALS & METHODS

Ewe Study

34 mixed breed white-faced mature ewes were randomly assigned to one of two groups. In group I, 17 ewes were placed in a fenced lot and fed free choice cull onions on the ground. The 17 control ewes in group II were kept in a small feedlot and fed an alfalfa hay and whole corn ration. Both groups had access to free choice water and minerals. All sheep were dewormed at the onset of the trial and fed their respective rations for 102 days.

Blood parameters, body condition scores, fleece weights, pregnancy rates, and lambing percentages of the onion-fed ewes compared to controls were assessed. Rumen fluid was collected for preliminary investigation of ruminal microbial flora and alterations in sulfur metabolism that could account for adaptation of sheep to a high onion diet.

Body condition scores were recorded on all ewes at the onset of the trial and on days 14 and 102. Blood samples were taken on the onset and again on days 14, 21, 28, 47, 67, and 102. Packed cell volumes (PCV) were determined and each sample was examined for the presence of Heinz bodies. Rumen gas sampling and rumen fluid was collected. Fleece weights, pregnancy rates, and lambing percentage were determined for all sheep. (figure 2)



* figure 2

Lamb Study

Fifty randomly selected, white face, mixed-breed, wether lambs were used in the study. Mean body weight was approximately 45 kg. Lambs were randomly allotted to five groups of 10 lambs, and held in separate pens 10 x 20 feet in size. The lambs were routinely vaccinated before arrival at the feedlot. The goal was to feed the lambs to attain a market weight of 59 to 69 kg. The lambs, which were accustomed to a feedlot concentrate finishing ration, were fed cull onions for 76 days. A ration of grain and/or whole onions was fed to the lambs at 3.5% of their body weight on an as received basis.

Lambs were weighed individually with a portable scale on day 0, 4, 11, 18, 25, 32, 39, 46, 53, 60, 68, and 76 prior to the morning feeding. Live weight was also obtained at time of arrival at the slaughterhouse (day 76). The control group was only weighed at day 0 and 76.

Blood samples were obtained on day 0, 42, and 76 to monitor the effects of onions on erythrocyte parameter. Control groups were bled only on day 0 and 76.

On the 76th day, all of the animals were slaughtered using conventional procedures. After the carcasses were chilled for 24 hours, they were graded and evaluated. USDA quality and yield grades were recorded. Loin samples from lambs in each treatment group were randomly selected for evaluation of taste and tenderness.

Meat samples were evaluated by a panel, which consisted of 32 undergraduate Animal Science students. Loin samples were cut into chops (1 inch thick) and evaluated for juiciness, tenderness, flavor intensity, flavor desirability, and overall palatability. An eight point descriptive scale was used (8 = extremely juicy, extremely tender, extremely intense, or extremely palatable; 1 = extremely dry, extremely tough, extremely bland, extremely undesirable, or extremely unpalatable).

RESULTS AND DISCUSSION

Ewe Study

In the pregnant ewe study, onion-fed sheep readily consumed the cull onions as soon as they were provided, and within a week, most ewes were consuming approximately 20 kg. of onions/day per ewe. As onions contained 92% water, water intake by the onion-fed ewes was low in comparison to that of the control ewes. A majority of the onion-fed ewes developed soft and sometimes transient watery diarrhea that smelled strongly of onion. The control group had no such abnormalities. (figure 3)

After 14 day of the trial, 16/17 onion-fed ewes had detectable Heinz bodies in their erythrocytes, and all but one had decreased PCV. The PCV decreased from an average of 37 (range 29-45) to 27 (range 19-36). Thirteen (81%) of the onion-fed ewes with Heinz bodies had PCVs < 30%. The PCVs of the onion-fed group were significantly lower than the controls at the 95% significance level using a directional t-test. By day 21 all onion-fed ewes had detectable Heinz bodies, and 14/17 (82%) had PCVs < 30%. The controls' average PCV declined from 37 (range 34-46) to only 36 (range 31-43), and no Heinz bodies were detected.

All onion-fed ewes remained positive for Heinz bodies as long as they were fed onions, although the number of animals that were strongly positive for Heinz bodies declined over time. By day 102 only one onion-fed ewe was Heinz body negative. After day 28 the severity of anemia reached a plateau and 10 of the onion-fed ewes had no further decline, or their PCV actually increased. The trend continued for the remainder of the onion-feeding period.

The development of Heinz body anemia in the onion-fed ewes was predictable and similar to other reports of onion poisoning in sheep. The onion-fed sheep had significantly lower PCVs than the control after being on the diet for 21 days, and thereafter the severity of the anemia did not worsen. In the majority of the onion-fed ewes, PCVs increased during the remaining 81 days of the trial, although none of the animals regained their initial PCV levels. As the test animals each continued to eat approximately 20 kg of onions/day, and all had Heinz bodies in the erythrocytes throughout the trial period (indicating a steady state of onion poisoning), the sheep adapted to the exclusive onion diet, avoiding the progressive and often fatal anemia seen in cattle with onion poisoning.

Adaptation to the exclusive onion diet was probably due to increased rumen metabolism of the propenylcystein sulfoxides that prevent excessive erythrocyte damage. Preliminary evidence for rumen adaptation was demonstrated by a marked increase in the number of sulfide-metabolizing *Desulfovibrio spp* organisms in the rumen of two of the onion-fed sheep. The two onion-fed sheep whose rumen gas was sampled for H₂S had appreciably more H₂S (1,000 and > 250 ppm) compared to the control (100 and < 100 ppm). The onion-fed sheep had significantly more sulfate-reducing bacteria (1.1×10^7 and 4.5×10^6 /ml) in the rumen samples than did the controls (1.5×10^4 and 9.5×10^3 /ml). The reduction of available sulfur in the rumen was indicated by the increased amount of H₂S detected in the rumen gas of sheep with increased numbers of sulfide-reducing microorganisms.

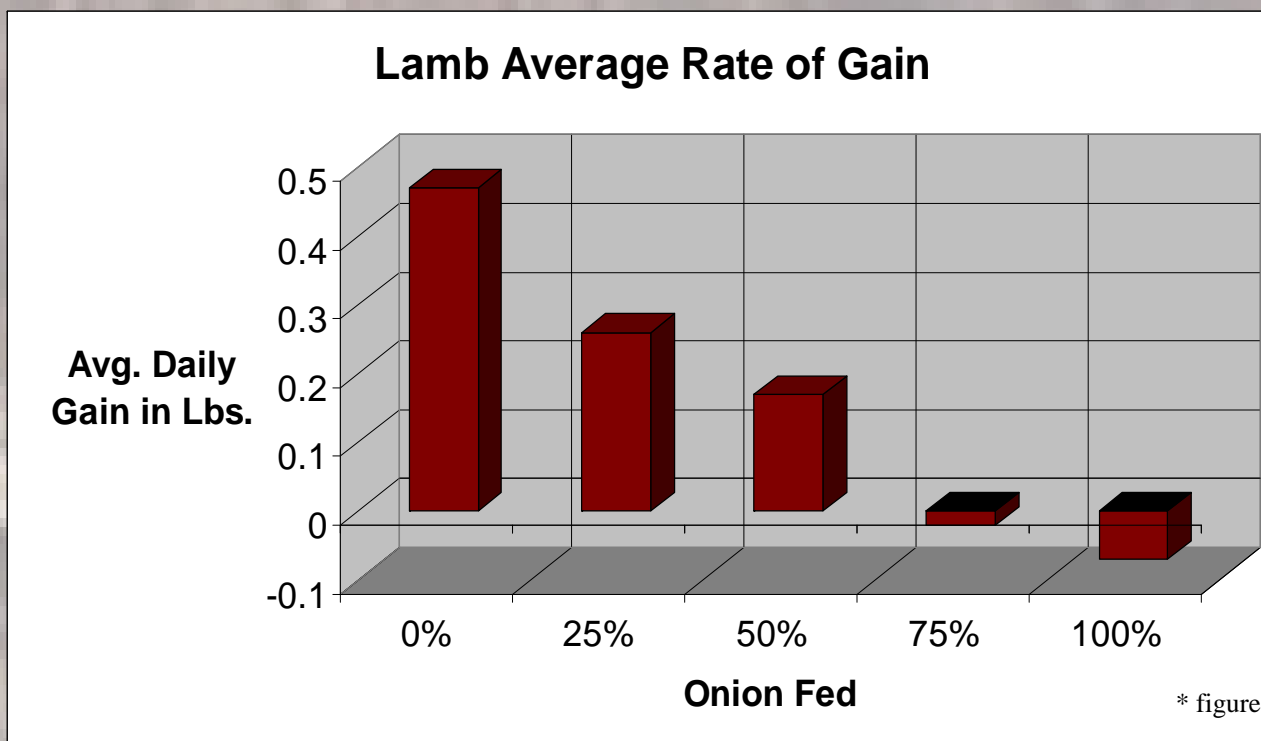
The ewes rapidly adapted to eating the cull onions, and although they all developed Heinz body hemolytic anemia, they did not appear adversely affected. Body condition scores, fleece weights, and reproductive performance of the ewes on an exclusive onion diet were comparable to the control fed a conventional alfalfa and grain supplemented ration.

Lamb Study

In the feeder lamb project the body weight of the lambs were statistically different ($P < 0.05$) between dietary groups. At day 0, square mean weight of all five groups was 45.5 kg. All four dietary groups fed onions lost approximately 5.9 kg from day 0 - 76. The mean body weight at day 76 was 67 kg, 59.9 kg, 55 kg, 51.8 kg, 47.31 kg, in the 25%, 50%, 75%, and 100% onion fed groups respectively. Overall, weight gain was 15.9 kg., 10.9 kg., 4.5 kg., 0.45 kg for the control, 25%, 50%, and 75% onion fed groups; but the 100% lost 4.72 kg.

While analyzing body weight over time a significant drop in mean body weight in all treated groups was observed between Day 0 and 4. This weight loss suggests that initially none of the lambs accepted the onions as a source of feed during the first three to four days of the trial. Thereafter, lambs adapted to their onion diet. All of the four treatment groups lost the same amount of weight in the first week. This suggested that feeding onions decreases feed intake, irrespective of the percentage of onion fed. Although lambs fed 25% onion in their diet reached acceptable market weight (smean = 59.5 kg), the mean weight for the group at 76 days was significantly lower compared to the controls (smean = 66.8 kg). The 50% and 75% groups recovered the mean weight they lost in week one by the 9th and 10th week respectively. The 50% group gained an acceptable market weight at the end trial (mean = 55 kg.) In contrast, the 75% group showed minimum weight gain over the feeding period. (figure 4)

This data shows that hemolytic anemia in the lambs is due to the toxic effects of onions on red blood cells. As the percentage of onions in the diet increased the percentage of red cells containing HB increased and PCV decreased due to the hemolytic anemia. The differences between the 25% and 100% groups compared to the other two groups in PCV and HB percentage at day 42 appeared to result from rejection of onion consumption in both groups. At the end of the trial, PCV was significantly lower for treated groups compared to the controls. Over time, a slight improvement of PCV for the 25%, 50%, and 75% groups occurred.



* figure 4

CONCLUSION

Although none of the lambs died from the toxic effects of the onions, all developed clinical signs of onion toxicity. However, sheep adapt to the harmful effects of sulfur compounds in the onions. When the percentage of onions in the diet exceeds 50% of the ration, there is a marked decrease in weight gains. Remarkably, the quality of the meat palatability was not affected.

If onions are to be fed as part of a complete ration, it is important that an adequate source of protein, energy, and minerals be supplemented as the average protein content in onions (8-9% on dry matter basis) is too low for growing feeder lambs. In addition, the high sulfur content of onions can interfere with copper and molybdenum absorption in the gastrointestinal system, and may warrant appropriate mineral supplementation.

The results of the slaughter lamb study indicated that cull onions could be used as an alternate feed source for finishing lambs with minimal impact on the overall palatability of the product. Based on commercial feed costs, cull onions can be used as various percentages of the diet to reduce feed costs. (figure 5)

* Moisture	92%
* Crude Protein	7.4 - 12.9
* TDN%	83 - 90
* Calcium	.31 - .54 (.35)
* Phosphorus	.34 - .52 (.40)

* figure 3

Treatment	Total Return (\$) 70¢/lb.	Feed Costs \$5.00 CWT	Net Return(s)	Feed Costs \$5.50 CWT	Net Return(s)
Controls	\$20.12	\$13.04	\$7.08	\$14.35	\$5.77
25% Onions	\$15.82	\$9.33	\$6.49	\$10.26	\$5.56
50% Onions	\$12.43	\$6.00	\$6.43	\$6.59	\$5.84

* figure 5

As the 4th largest sheep producing state, Colorado has developed a mutually beneficial program between sheep and onion producers.

An annual problem onion farmers face is the disposal of large quantities of cull onions (*Allium cepa*). Disposal of cull onions in most municipal landfills is severely prohibited because of the high water content, nitrate levels, and the smell of decomposing onions. Leaving onions in the field to rot promotes the build-up of plant pathogens that subsequently affect future crop production. Consequently, onion producers have developed a mutually beneficial relationship with sheep and cattle producers who are willing to feed cull onions to livestock. In many circumstances, cull onions are provided free of charge to the livestock producer in return for their removal and disposal of the onions. Numerous studies have shown that cattle and sheep can effectively use limited quantities of cull onions in their diet. However, onion poisoning readily occurs if livestock consume excessive quantities of onions. Sheep adapt the best to eating onions, and are the most tolerant of the toxic effects of onions.