# Effects of Corn Steep Liquor Supplementation On Intake and Digestion of Tallgrass Prairie Hay Contaminated with Sericea Lespedeza

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## Introduction

Sericea lespedeza (*Lespedeza cuneata*) is a noxious weed that infests approximately 600,000 acres of native range in Kansas. Intake of sericea lespedeza by grazing beef cattle is poor due to the presence of condensed tannins in the plant. Condensed tannins reduce protein digestion by beef cattle and may also decrease plant palatability because of their astringent nature.

Prolific seed production, in combination with little or no grazing pressure, has contributed to the rapid spread of sericea lespedeza in the Flint Hills. Increasing grazing pressure on sericea lespedeza may reduce seed production and slow its advance; however, the presence of condensed tannins inhibit consumption by grazing animals. Reports have indicated that feed-grade polyethylene glycol may inhibit formation of tannin-protein complexes in the rumen, but beef producers have not widely adopted polyethylene glycol because, at the rates necessary to increase intake of sericea lespedeza, it is cost-prohibitive and disallowed by regulations. Therefore, identifying substances that are generally regarded as safe (GRAS) by the U.S. Food and Drug Administration, cost-effective, and that mitigate the consequences of consuming a diet high in tannins is advantageous. Such information could lead to a degree of biological control of this noxious weed using the most economically important grazer (i.e., beef cattle) in the Flint Hills.

Preliminary research in our laboratory indicated that corn steep liquor has binding affinity for condensed tannins that is similar to polyethylene glycol. Therefore, the objective of our study was to determine the effects of corn steep liquor supplementation on intake and digestion of tallgrass prairie hay contaminated by sericea lespedeza.

## Experimental Procedures

Tallgrass prairie forage contaminated with sericea lespedeza was harvested from a single pasture in Greenwood County, KS, sun-cured, packaged in bales, and stored at the Kansas State University Commercial Cow-Calf Unit. Forage was harvested in late July, which corresponded to the budding stage of sericea lespedeza. Concentrations of condensed tannins in the plant are typically greatest at this stage of growth. Plant-species composition on the study site was estimated using a modified step-point technique. Sericea lespedeza comprised 19.3% of all plants encountered during the procedure. Aboveground biomass of sericea lespedeza averaged 893 lb/acre. Bales of contaminated hay selected for the study were ground separately to a 4-inch particle size.

Corn steep liquor was purchased from Archer Daniels Midland in Columbus, NE, transported to the Kansas State University Commercial Cow-Calf Unit, and stored in a polyvinyl chloride container.

Twenty-four mature beef cows (average initial weight = 1,022 ± 153 lb; average initial body condition score = 4.2 ± 0.8 [1 = thin, 9 = very fat]) were used in the study. Cows were housed in a single pen and were fed individually using a Calan gate system (American Calan, Northwood, NH). Cows were stratified by body weight and body condition score and were assigned randomly to be supplemented with 0, 1.34, 2.68, or 4.03 lb/day (dry basis) of corn steep liquor (equivalent to 0, 3, 6, and 9 lb/day on an as-is basis; Table 1).

Cows were trained to use the Calan gate feeding system over a period of approximately 30 days. During this time, all cows were fed sericea lespedeza-contaminated forage free choice. When dry matter forage intake stabilized at approximately 1.2% of body weight, the trial was initiated. All cows were fed sericea lespedeza-contaminated forage free choice for the first 14 days of the trial. Beginning on day 15, supplemental corn steep liquor was abruptly introduced into cow diets at assigned feeding levels; it was offered once daily and was consumed by cows within 30 minutes. Forage and supplement intake were monitored during the following 14 days. The purpose of the abrupt introduction of corn steep liquor into cow diets was to minimize the opportunity for ruminal microbes to adapt to nutrients in corn steep liquor.

Daily voluntary dry matter intakes were determined by subtracting daily refusals from the total amount of hay offered. Intakes were expressed as a percentage of initial cow body weight. Total-tract diet digestion was assessed from day 23 to 29. Forage samples were collected from day 23 to 28. Fecal grab samples were collected every 4 hours on days 24 through 29. The collection interval was staggered 2 hours each day to account for diurnal variation in fecal output and composition.

## Results and Discussion

Prior to the introduction of corn steep liquor, voluntary forage dry matter intake did not differ ($P = 0.52$) between treatments. After introduction of corn steep liquor (day 15 through 29), supplemented cows ate more ($P \leq 0.01$) forage dry matter than unsupplemented cows; however, there were no differences ($P \geq 0.38$) in forage dry matter intake for cows fed varying amounts of corn steep liquor (Table 2). The smallest dose of corn steep liquor used in our trial (i.e., 1.34 lb/day) stimulated maximum intake of tallgrass prairie hay contaminated with sericea lespedeza in a short-term experiment.

Total-tract dry matter digestibility was greater ($P < 0.01$) for cows fed 2.68 or 4.03 lb/day corn steep liquor than for cows fed 0 or 1.34 lb/day (Table 2). Total-tract crude protein digestion was least ($P < 0.01$) in cows fed no corn steep liquor, was slightly greater ($P < 0.01$) in cows fed 1.34 lb/day corn steep liquor, and was greatest ($P < 0.01$) in cows fed either 2.68 or 4.03 lb/day corn steep liquor. Total digestible dry matter intake by cows fed 2.68 or 4.03 lb/day corn steep liquor was greater than that of cows fed 0 or 1.34 lb/day corn steep liquor. The amount of corn steep liquor needed to optimize digestion characteristics of the diet was equal to or greater than 2.68 lb/day. Further research is warranted to evaluate the optimal corn steep liquor dose needed to mitigate the consequences of consuming high-tannin diets.

## Implications

Supplementation of corn steep liquor may increase tolerance of beef cows for high-tannin forages. In our study, supplemental corn steep liquor ameliorated the negative consequences of tannin consumption in a dose-dependent manner when fed to beef cows in confinement. Whether supplemental corn steep liquor can influence forage selection preference when grazing cattle have the opportunity to eat either uncontaminated forage or forage contaminated by sericea lespedeza remains unknown.

**Table 1. Chemical composition (dry matter basis) of corn steep liquor and tallgrass prairie hay contaminated by sericea lespedeza**

| Item, % | Corn steep liquor | Contaminated forage |
|---|---|---|
| Dry matter | 44.7 | 93.7 |
| Organic matter | 95.2 | 87.2 |
| Crude protein | 32.8 | 4.6 |
| Acid detergent fiber | - | 40.7 |
| Neutral detergent fiber | 0.4 | 65.2 |
| Calcium | 0.03 | 0.35 |
| Phosphorus | 0.62 | 0.07 |

**Table 2. Effects of increasing dose of corn steep liquor on intake and digestion of tallgrass prairie hay contaminated by sericea lespedeza**

| | Corn steep liquor, lb/day (dry basis) | | | | |
|---|---|---|---|---|---|
| Item | 0 | 1.34 | 2.68 | 4.03 | SEM |
| Feed intake, % of body weight | | | | | |
| Forage dry matter | 1.38$^{a}$ | 1.59$^{b}$ | 1.58$^{b}$ | 1.63$^{b}$ | 0.065 |
| Digestible dry matter | 0.86$^{a}$ | 1.16$^{ab}$ | 1.58$^{bc}$ | 1.86$^{c}$ | 0.062 |
| Total-tract digestibility, % | | | | | |
| Dry matter | 52.6$^{a}$ | 55.6$^{a}$ | 65.6$^{b}$ | 66.3$^{b}$ | 2.08 |
| Crude protein | −1.5$^{a}$ | 18.6$^{b}$ | 51.7$^{c}$ | 52.3$^{c}$ | 4.53 |

$^{abc}$ Means within a row lacking common superscripts are different.