

# Sun-Curing and Harvest Maturity Impacts Concentration and Protein-Binding Capacity of Condensed Tannins in *Sericea Lespedeza* (*Lespedeza Cuneata*)

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## Introduction

*Sericea lespedeza* (*Lespedeza cuneata*) is a noxious weed that infests approximately 600,000 acres of native tallgrass range in Kansas. Intake of *sericea lespedeza* by grazing livestock is poor, presumably as a result of the plant's tannins. Condensed tannins reduce protein digestion by ruminants and may also decrease plant palatability.

Prolific seed production, in combination with little or no grazing pressure, has contributed to the rapid spread of *sericea lespedeza* on Kansas rangelands. Increasing grazing pressure on *sericea lespedeza* may reduce seed production and slow its advance; however, development of appropriate research models to study *sericea lespedeza* intake by ruminants has been slow. Tannin concentration in *sericea lespedeza* changes dramatically during drying and storage. Therefore, avoidance of *sericea lespedeza* by grazing livestock is not generally observed when *sericea lespedeza* is fed to livestock in the form of sun-cured hay. Little is known about how harvest maturity and sun-curing influence the concentration of condensed tannins in *sericea lespedeza* or the degree of protein-binding by condensed tannins over the course of an entire growing season. Such information could lead to more effective research models for the study of *sericea lespedeza* intake by ruminant livestock. Therefore, the objective of our study was to examine changes in condensed-tannin concentrations and in protein-binding capacity of condensed tannins throughout the growing season in both sun-cured and fresh *sericea lespedeza*.

## Experimental Procedures

### *Sample Collection and Preparation*

Samples were collected throughout the summer of 2009 from a single 160-acre pasture in Greenwood County, Kansas. Plant-species composition was determined using a modified step point technique; *sericea lespedeza* comprised 19.3% of all plants encountered during the procedure.

Individual plants were collected at 1- to 4-week intervals from June 24 to October 11 ( $n = 200$  plants per sampling date) that corresponded to single-stem, branch-stem, budding, flowering, and senescent stages of plant growth. At the time of collection, samples were either allowed to sun-cure in burlap bags or were flash-frozen. Flash-frozen samples were preserved by freeze drying and dried samples were ground with dry ice to prevent polymerization of tannins.

### ***Extraction and Determination of Condensed Tannins***

Tannins were extracted using a methanol extraction procedure. Samples were combined with 1.69 oz of 50% methanol (volume/volume). Samples were agitated for 20 minutes then centrifuged to remove solids. The supernatant was removed and used for further analysis. Condensed tannin concentrations were measured using a modified butanol-HCl reaction. Reaction mixtures were read at 550 nm on a spectrophotometer and absorbance was adjusted to concentration of condensed tannin using luecocyandin as a standard.

### ***Determination of Protein-Precipitable Phenolics***

Protein-precipitable phenolics were determined through a reaction between ferric chloride and tannin phenolics. This reaction produced a pink chromatophore that could be read spectrophotometrically. These samples were read on a spectrophotometer with prepared standards at 510 nm. Concentrations were determined using a standard curve after accounting for the amount of sodium dodecyl sulfate solution that was added.

## **Results and Discussion**

### ***Condensed Tannins***

Allowing forage to sun-cure substantially decreased concentrations of detectable condensed tannins at all stages of sericea lespedeza maturity (main effect of treatment  $P < 0.001$ ). Concentrations of condensed tannins were different in both treatments at each stage of sericea maturity (main effect of harvest date  $P < 0.05$ ). Concentrations of condensed tannins were lowest in June and October and peaked in August (Figure 1). Peak concentrations corresponded to the flowering stage of the sericea lespedeza life cycle.

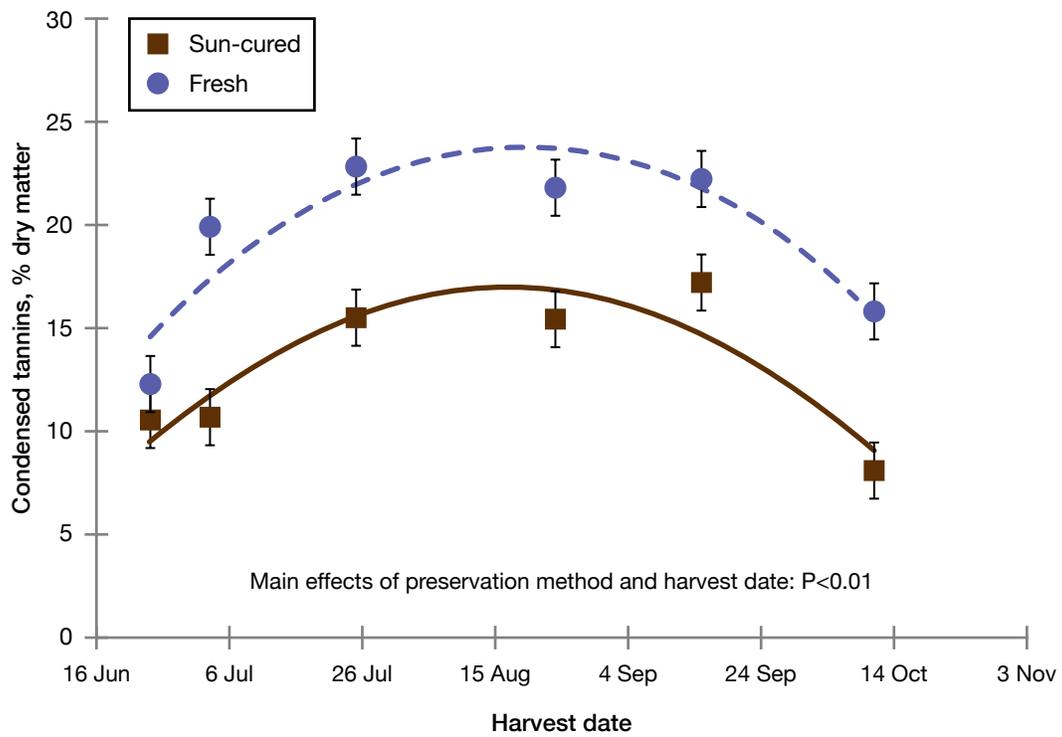
### ***Protein-Precipitable Phenolics***

Concentrations of protein-precipitable phenolics were decreased by sun curing sericea lespedeza (Figure 2). Protein-binding capacity differed at each stage of growth ( $P < 0.01$ ). The magnitude of the effect changed over time and was influenced by treatment (treatment x time interaction,  $P < 0.01$ ; Figure 2). The protein-binding capacity was least during June and October and again peaked in August. These quadratic responses of the fresh frozen sericea lespedeza suggest that condensed tannins in sericea lespedeza retained their ability to bind proteins late into the growing season.

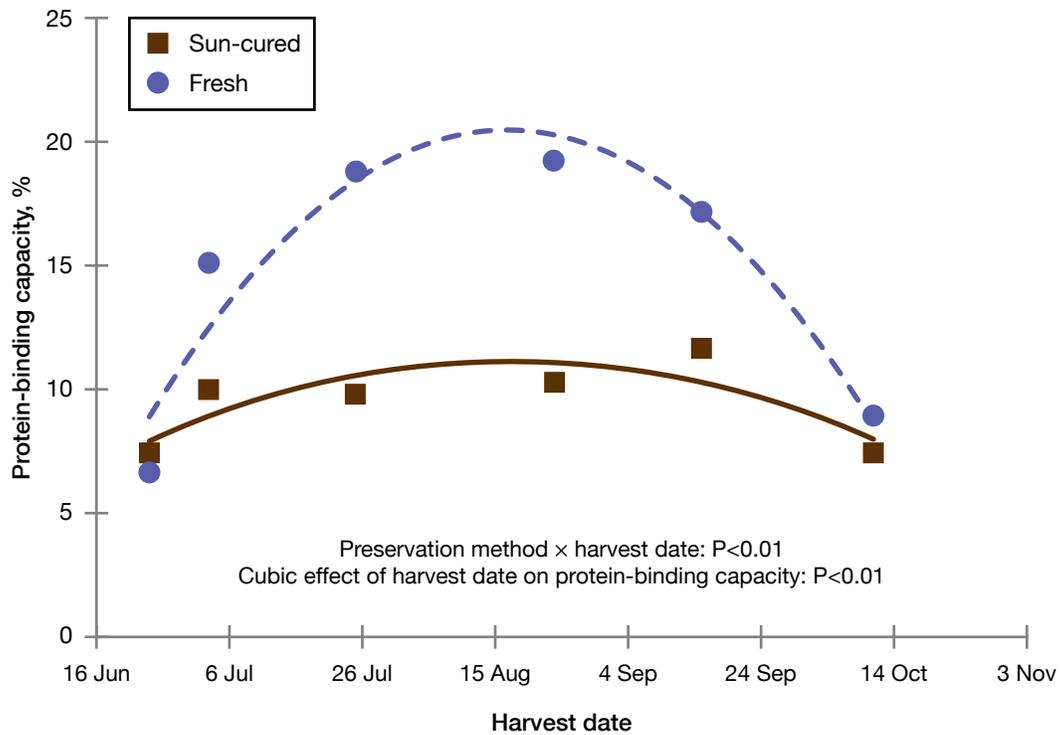
## **Implications**

Results from this study suggest that allowing sericea lespedeza to sun-cure after harvest can dramatically decrease the amount of extractable condensed tannins and the capability of condensed tannins to bind proteins. Moreover, condensed tannin concentration and protein-binding capability peaked near the flowering stage of sericea lespedeza. These data may explain why sharp avoidance of sericea lespedeza exhibited by grazing livestock is difficult to replicate in a laboratory setting when the plant is offered to livestock in the form of sun-cured hay. Understanding how drying and plant growth stage influence condensed tannin concentrations and protein-binding capacity of sericea lespedeza could lead to more effective research models for the study of sericea lespedeza intake by ruminant livestock.

## NUTRITION



**Figure 1. Effects of sun-curing and harvest date on concentration of condensed tannins in sericea lespedeza.**



**Figure 2. Effects of sun-curing and harvest date on the protein-binding capacity of condensed tannins in sericea lespedeza.**