

Smart Man's Sericea Lespedeza and Worm Control: A Review

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Abstract: Sericea lespedeza (*Lespedeza cuneata* (Dum. Cours.) G. Don.) has historically been called “poor man’s alfalfa”, because of its ability to grow on marginal soil with the minimal inputs of lime or fertilizer. With recent research detailing the potential health benefits of this forage to animals, it may be time for a new nickname. Although sericea lespedeza has been used for soil conservation and as an inexpensive (low-input) source of pasture or hay crop for nearly 100 years, research over the last 10-15 years has demonstrated the excellent bioactivity of this plant against infection with gastrointestinal nematodes (*Haemonchus contortus*) and protozoan parasites (*Eimeria* spp.) in livestock. This bioactivity, which has been attributed to a unique type of condensed tannins (CT), has been confirmed in both fresh (grazed) and dried (hay, meal, pellets) forms of sericea lespedeza in a number of studies with sheep, goats, and cattle. There is on-going research with this forage to determine the effect of ensiling on its bioactive properties and to validate its anti-parasitic effects on-farm. Future research will focus on determining the mode of action of sericea lespedeza tannins against internal parasites and the interplay between the nutritional value and the health benefits of this plant.

Key words: Coccidia, *Haemonchus contortus*, sericea lespedeza, sheep, goats.

1. Introduction

Since the 1930’s and 1940’s, sericea lespedeza (*Lespedeza cuneata* (Dum. Cours.) G. Don.) has been a cultivated plant in the United States (US) [1]. Sericea lespedeza is a tannin-rich warm-season perennial legume that has been called “poor man’s alfalfa”, because it can produce forage under marginal soil conditions. It has the ability to tolerate drought-prone, infertile, acidic soils and grow well on sloping land with the minimal lime and fertilizer inputs [2]. With recent research on the potential health and environmental benefits of including sericea lespedeza in the diet of ruminant animals, this forage has earned a new nickname. Well-adapted to the warm, moist environment of the Southern and Eastern US and the acid velds of Southern Africa [3], this non-bloating forage also lowers ruminal methane production in grazing livestock, reducing the

contribution of this powerful greenhouse gas to global warming [4, 5]. However, the main reason that it may be time to change sericea lespedeza’s name to “smart man’s alfalfa” is the effect of its tannins on internal parasites of livestock. In an era when anthelmintic drugs are rapidly losing their effectiveness against gastrointestinal nematodes (GIN), particularly *Haemonchus contortus*, the infamous blood-sucking GIN commonly known as “wireworm”, “red stomach worm” or “barber’s pole worm” [6, 7], research over the last 10-15 years has demonstrated the excellent anti-parasitic properties of sericea lespedeza in fresh (grazed) or dried (hay, leaf meal, pellets) forms in the diet of sheep, goats, and other ruminants, not only against *H. contortus*, but also against *Eimeria* spp., a protozoan parasite that causes coccidiosis and can have devastating effects on young animals (lambs and kids) [8-11]. The purpose of this review is to provide an update on recent research related to the anti-parasitic bioactivity of sericea lespedeza and a description of where future work might lead with this

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nutraceutical forage.

2. History of Sericea Lespedeza

Sericea lespedeza has been used for soil conservation and as forage for livestock in the US for nearly 100 years and as a grazing and hay crop in South Africa for over 30 years [12]. Introduced to the US at the North Carolina Experiment Station in 1896, sericea lespedeza was used extensively for reducing soil erosion on disturbed soils and for strip mine reclamation in the 1920's and 1930's, and as a pasture species beginning in the 1940's [13]. The sericea lespedeza cultivars available at the time, such as Arlington (released in 1939) and Okinawa (available in 1944), had thick stems, which lowered palatability and animal performance [1, 14]. A breeding program to improve this species was initiated at Auburn University in Alabama in the 1950's, resulting in the release of high-tannin cultivars with thinner stems and lower fiber content ("Serala" and "Interstate") in the 1960's [15, 16], lower tannin concentrations ("AU Lotan") in 1980 [17], and improved grazing tolerance ("AU GrazerTM") in 1997 [18].

In the US, older sericea lespedeza cultivars are still used for stabilizing disturbed soils from surface-mined coal sites, road banks and other disturbed or eroding sites, and for improving wildlife habitats [1]. AU GrazerTM is the primary cultivar planted as a grazing and hay crop for livestock production in this country [1]. While most productive in the southeastern states, sales of AU GrazerTM seed have been increasing throughout the Southern, Eastern and Northern US, from Florida to Texas to Minnesota.

In South Africa, while AU GrazerTM is being planted and used for pasture and hay on commercial farms, the most widely planted sericea lespedeza cultivar is AU Lotan that has been adapted to South Africa growing conditions. In a plot trial completed in the 1980's in the lowveld, middleveld and highveld areas of Swaziland [3], several sericea lespedeza cultivars (Interstate 76, Serala, AU Donnelly and AU

Lotan) produced very well in the acidic conditions of the middleveld (950 m elevation) and highveld (1,500 m) sites (pH of 4.8 and 4.0, respectively), and produced poorly on the basic soils (pH 8.0) of the lowveld (150 m). Although dry matter production of AU Lotan was lower than Interstate 76 and AU Donnelly in this trial, AU Lotan has become the most widely-utilized cultivar in the summer rainfall regions of South Africa, thanks to the perseverance of pioneering commercial farmers who refused to give up on sericea lespedeza after early planting failures [12]. Sericea lespedeza may also have potential as a forage crop in other countries in Southern Africa with a similar summer rainfall pattern and acid velds, including Namibia, Botswana, Zimbabwe, Mozambique and Zambia.

3. Agronomic, Environmental and Health Benefits of Sericea Lespedeza

Sericea lespedeza has a number of desirable qualities that make it useful as a forage crop and as a conservation plant. It can be grown on a wide range of soil types, including acidic, infertile sites that will not support growth of other forage legumes [19]. As a legume, it needs no nitrogen (N) fertilization. Because of its tolerance of high free Al³⁺ levels, sericea lespedeza roots grow deeply in acidic soils, making it very drought-tolerant [2]. Deep rooting of sericea lespedeza also reduces its need for phosphorus (P) fertilization, as it is excellent at extracting this element from soil [20]. Reduced need for lime and fertilization with N and P makes sericea lespedeza an inexpensive pasture and hay crop compared to other forages. Sericea lespedeza is also an excellent seed producer and is generally resistant to damage from insects and diseases [19]. With a deep root system, ability to persist under a wide range of soil conditions and its tendency to shed lower leaves, sericea lespedeza is an ideal conservation plant, building soil fertility, improving soil structure and reducing erosion. It is also environmentally-friendly as a feed for ruminants,

reducing activity of methanogenic bacteria in the rumen [4, 5, 21].

The health benefits of this plant to both animals and humans include its anti-bloat, anti-microbial (including pathogenic bacteria, such as *Escherichia coli*) and anti-parasitic properties [9, 22]. All of these characteristics of sericea lespedeza are thought to be related to the high concentration and unique structure of its condensed tannins (CT). Structural analysis has revealed high concentrations of CT compounds of high molecular weight, up to 98% "prodelphinidin-type" tannins in the leaves of sericea lespedeza [23]. These tannins are very reactive with protein, possibly including those on the surface of adult parasites, as well as their eggs and larvae [11, 24]. Condensed tannins with a high prodelphinidin/procyanidin ratio (CT monomers) have been suggested to have a greater effect on GIN than less reactive CT types [25, 26].

4. Anti-parasitic Properties of Sericea Lespedeza

The first reports on the anti-parasitic properties of sericea lespedeza came from grazing work with goats in Oklahoma, by Min et al. [27] who reported a 57% reduction in GIN egg counts in feces of goats grazing sericea lespedeza compared with similar animals grazing grass pasture. Lower numbers of *H. contortus* (94%), *Teladorsagia circumcincta* (100%) and *Trichostrongylus colubriformis* (45%) were observed in "tracer" animals grazing sericea lespedeza compared with tall fescue (*Festuca arundinacea*) pastures [28]. In the first trial demonstrating anti-parasitic effects of sun-cured sericea lespedeza hay, Shaik et al. [29] reported lower GIN egg counts in goats fed ground sericea lespedeza compared with ground bermudagrass (*Cynodon dactylon*) hay. In a follow-up study, Shaik et al. [30] reported an 80% drop in GIN egg counts in feces of goats a week after being fed long (unground) sericea lespedeza hay compared with bermudagrass hay at 75% of daily

intake, and these differences remained throughout the 6-week feeding trial. The sericea lespedeza-fed goats also had improved blood packed cell volume (PCV), reduced development of infective larvae (L₃) from GIN eggs in feces, and reduced adult worm numbers in their abomasum and small intestines. Total reductions in adult female GIN were 77%, 36% and 50% for *H. contortus*, *T. circumcincta* and *T. colubriformis*, respectively, in goats fed sericea lespedeza compared with bermudagrass hay diets [30]. In a similar study with sheep fed sericea lespedeza and bermudagrass diets, Lange et al. [31] reported 67%-98% lower GIN egg counts in sericea lespedeza-fed animals throughout a 49-day trial, and a greater effect of sericea lespedeza on reducing existing *H. contortus* worm burdens (67%) compared with establishment of incoming larvae (26.1%).

Sericea lespedeza can be grazed, fed as hay, ground and fed as whole plant or leaf only meal, processed into whole plant or leaf only pellets, or ensiled. Preserving and processing sericea lespedeza gives farmers greater flexibility in the use of this forage on their farm, and facilitates storage and shipping to areas where sericea lespedeza does not grow well. However, any type of drying or processing of sericea lespedeza generates heat, reduces extractable CT and increases CT bound to protein [32, 33]. Recent work has also demonstrated that sun-curing and pelleting of sericea lespedeza can even change CT structure, increasing the polymer size of CT molecules [11, 23]. The question is how does processing of sericea lespedeza affect its anti-parasitic bioactivity? So far, the answer has been uniformly positive. As previously mentioned, sun-curing and grinding do not significantly change the anthelmintic efficacy of sericea lespedeza compared with grazed forage. This is important because sun-curing reduces extractable CT content of high-tannin sericea lespedeza (Interstate 76) and improves the palatability and digestibility of this forage for sheep [34]. Pelleting of AU Grazer sericea lespedeza further reduced extractable CT

concentrations, but did not reduce the plant's anti-parasitic properties in goats, whether fed as the primary diet [33] or as a supplement on grass pasture [35]. In a recent study comparing sericea lespedeza hay, ensiled sericea lespedeza and bermudagrass hay fed to goats as 70% of diets balanced for protein and energy, there was no effect of sericea lespedeza processing method on GIN egg counts and coccidial (*Eimeria* spp.) oocyst counts in feces, but goats on either sericea lespedeza diet reduced counts by 75.5% and 88.6%, respectively, compared with control animals two weeks after initiation of feeding [36]. Other studies have demonstrated very good effectiveness of pelleted sericea lespedeza against *Eimeria* infection (up to 98% reduction compared to non-CT control pellets) in both sheep [10] and goats [11]. Promising results of reduced GIN egg counts have also been observed in preliminary studies with beef cattle fed sericea lespedeza as hay or in pellet form [1] and llamas fed SL in round bales [37] compared with non-tannin control forages.

Other research questions with sericea lespedeza that needed to be addressed included: (1) how much sericea lespedeza was required to achieve the anti-parasitic effect (what percentage of the diet); (2) can the parasites develop resistance to the effect of CT; (3) what are the nutritional consequences of including sericea lespedeza in livestock diets?

An initial answer to question one was provided in a study published by Terrill et al. [38], in which diets differing in sericea lespedeza content (0%, 18.8%, 37.5% and 56.3% sericea lespedeza) were fed to parasitized goats. Results showed that 37.5% and 56.3% sericea lespedeza diets significantly reduced GIN egg counts compared with the control diet (0%), but only goats fed with the 56.3% sericea lespedeza diet had lower numbers of adult worms. The conclusion from a second dose titration study with growing meat goat kids comparing pelleted whole plant sericea lespedeza and commercial pellets fed at 0%, 20%, 40% and 60% of the diet was the more

sericea lespedeza the better, because there was a linear reduction in GIN egg counts in feces as the percentage of sericea lespedeza in the diet increased [39]. In a study comparing ground whole plant sericea lespedeza with ground sericea lespedeza leaf meal fed to goats at 25% of each ration, both diets reduced GIN egg counts from pre-trial levels, but the leaf meal diet reduced egg counts more quickly [40]. Retaining leaves is an important consideration when drying and processing sericea lespedeza, because the leaves are higher in protein and CT content (16.0 g versus 3.3 g tannin content per 100 g dry weight in leaf and stem sericea lespedeza, respectively) [23].

The answer to the second question is still to be determined. So far, sericea lespedeza grazing and confinement feeding trials with both goats and/or sheep have shown fairly consistent anti-parasitic results in work completed in Georgia, Louisiana and North Carolina with AU GrazerTM [9]. The possibility of regional differences in GIN susceptibility to the effects of dietary sericea lespedeza, particularly with long-term exposure to CT needs to be explored further.

The question of the nutritional value of sericea lespedeza in livestock diets has been debated for a long time. Intake of the older cultivars of sericea lespedeza was low by grazing cattle, with the problem thought to be due to high levels of fiber and CT. Based upon observations that cattle will graze even common sericea lespedeza when it is young, or the top 20 cm of more mature plants, which are just as high in CT as the rest of the plant [41], it is now generally accepted that once the animal gets used to the taste of sericea lespedeza, their consumption level is based more on plant maturity than CT concentration. In addition, processing of high CT sericea lespedeza into hay improves intake compared with fresh forage in sheep [34]. Generally, performance (daily gain) of livestock grazing or fed hay of improved cultivars of sericea lespedeza have been comparable to or better than perennial warm-season grasses, such as

bermudagrass, which are the mainstay of grazing systems in the Southern US [2, 19]. In a 49-day trial with weaned calves given supplemental soy hulls and either free-choice AU Grazer™ sericea lespedeza hay or bermudagrass hay in round bales, daily gains for the sericea lespedeza and bermudagrass groups were 676 g/day and 626 g/day, respectively [19]. Average daily gains in parasitized and unparasitized goats fed either sericea lespedeza or bermudagrass hay at 75% of daily intake were 104 g/day and 75 g/day, respectively [42].

One of the questions about long-term feeding of sericea lespedeza concerns the effect on micronutrient status of livestock. In several recent studies with kids and lambs, long-term sericea lespedeza feeding reduced serum molybdenum (Mo) and cobalt (Co) levels compared with animals fed non-tannin (control) diets, although the effect on animal performance is still unclear [43]. In other studies, there was no clear effect of sericea lespedeza feeding on blood micronutrient status in lambs [44] and yearling goats [45].

5. Feeding Recommendations for Parasite Control Using Smart Man's Lucerne

All of the fresh (grazed), dried (hay, leaf meal, pellets) or preserved (ensiled) forms of sericea lespedeza that have been tested so far have showed some level of anti-parasitic activity against GIN, particularly *H. contortus*, and in more recent studies, against the protozoan parasites (*Eimeria* spp.) that cause coccidiosis [9-11, 36]. Based on this work, the current recommendations for using sericea lespedeza for parasite control in livestock are to feed it in its various forms at 25% or more of the diet (along with other sources of supplemental energy or protein as needed to meet nutritional needs of specific classes of animals). For control of *Eimeria* spp., begin feeding two weeks prior to periods of stress that might lead to outbreaks of coccidiosis, such as weaning of kids or lambs, and then continue for an

additional six weeks afterwards. For barber pole worm, use a similar approach, feeding prior to and during times of stress, particularly in classes of animals that are most susceptible to parasitic infection, such as kids and lambs at weaning and adult females during parturition and early lactation, particularly if they are suckling twins or triplets. Feeding longer than eight weeks for younger animals is not recommended, as in some locations/farms, the CT in sericea lespedeza may bind some trace minerals and may slow weight gains [43]. This does not seem to be a problem with long-term sericea lespedeza feeding in more mature animals [45]. When sericea lespedeza feeding is discontinued, the animals should be observed closely for signs of parasitic infection using FAMACHA© [46] or the Five Point Check© [47], and if needed, treated using 0.5 g of copper oxide wire particles (for *H. contortus* infection) [48, 49] or an effective anthelmintic.

6. Future of Sericea Lespedeza

Research is continuing on the unique structure and bioactivity of tannins in different cultivars of sericea lespedeza and the effects of various preservation and processing methods on these properties. With its many agronomic advantages (low-input, tolerant of acidic, infertile soils, drought tolerance, resistant to insect and disease damage, soil-building properties) and animal health benefits (non-bloating, anti-parasitic), as well as its flexibility in form of feeding (grazing, hay, pellets, silage), sericea lespedeza has tremendous potential to improve sustainability of animal-based agriculture both on large commercial farms as well as with small and limited resource farmers. With a source of pelleted sericea lespedeza leaf meal now commercially available in the US and sources of sericea lespedeza seed in both the US and South Africa, the use of this plant as an anti-parasitic forage for both small and large ruminants is likely to continue growing in the US, Africa and other parts of the world.

7. Conclusions

Because of its high anti-parasitic bioactivity, including sericea lespedeza in the diet of ruminant animals, whether fed fresh (grazed) or in dried (hay, meal, pellets) or ensiled forms, has potential to improve sustainability of animal production systems world-wide. With its agronomic, health and environmental benefits, it may be time to change the nickname of this forage from “poor man’s alfalfa” to “smart man’s alfalfa”.

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