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PREVALENCE OF GASTROINTESTINAL PARASITES IN LACTATING KIKO DOES AND THEIR KIDS IN WOODLANDS WITH SUPPLEMENTS

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Abstract
Gastrointestinal (GI) parasites pose a major health concern in goats raised in pastures. The study objective was to evaluate GI parasites' prevalence in lactating Kiko does and kids stocked in woodlands with supplemental grazing or feedstuffs. Seventeen lactating Kiko does, and their thirty-three kids were divided into two groups. Group 1 was supplemented with grazing in silvopastures and Group 2 with *ad libitum* hay and corn (0.5% of metabolic weight) along with stocking in woodland plots rotationally. Fecal samples were analyzed for type and quantity of GI parasites from animals having FAMACHA score 3 and higher. Group-1 does showed a better FAMACHA score and lower parasite infestation vs. Group-2 does. However, kids in Group 1 had a higher infestation of helminth parasites, but lower coccidia counts. This study indicated that grazing quality pastures is a better option for supplementing lactating does stocked in woodlands vs. feedstuffs.
Keywords: FAMACHA score, Kiko goats, Silvopasture

Introduction
Goat production enterprises in the U.S. mainly depend on pastureland. The pastures in the Southern Region of the U.S. are low productive and insufficient to feed small ruminants year-round (Karki, 2020). Inclusion of woodlands into the grazing system could be one of the viable options to increase the grazing opportunities for small ruminants from late spring (April/May) to mid-fall (September/October) (Karki, 2017). Moreover, woodland grazing minimizes the gastrointestinal (GI) parasites infestation because of two reasons. The first reason is the low chance of picking up parasite larvae from browse species, as a high density of parasite larvae remains within 2-3 inches from the ground surface. The second reason is anthelminthic characteristics of plant secondary metabolites, especially condensed tannins, present in woodland vegetation (Karki, 2017). Previous studies in woodland grazing by Bhattrai (2019) reported that the performance of mature Kiko wethers and Katahdin rams were satisfactory; however, the performance of young and growing animals was suboptimal, and they require nutrition supplements (Karki, 2020; Khatri, 2016). Stocking of lactating animals in woodlands requires proper supplementation for satisfactory performance and for resiliency against GI parasites when stocked in woodlands.

GI parasites pose a significant health concern in goats raised in pastures (Karki, 2013). Tapeworms, roundworms, and coccidia are predominant GI parasites in grazing animals (Karki, 2013). Barber-pole worm (*Haemonchus contortus*) is the most troublesome parasite for small ruminants raised on pastures in the southeast US (Miller, 2018). According to the U.S. Department of Agriculture Animal and Plant Health Inspection Service, Veterinary Health Services, National Animal Health Monitoring System [USDA APHIS VS NAHMS] (2017) survey looking at non-predator-related animal death, internal parasitism was the primary cause of goat deaths (22.7%). In the Southeastern U.S., internal parasites caused 23.2% of goat deaths (USDA APHIS VS

NAHMS, 2017). The climatic conditions in the southeast US are conducive to the growth and establishment of a large population of GI parasites (Miller, 2018). This causes the huge loss of goats in the Southeast.

Parasite infestation in animals differs according to their physiological stages. Animals are highly susceptible to parasites during pregnancy and lactation (Miller et al., 2012; National Research Council [NRC], 2007). Chauhan et al. (2003) found higher fecal egg counts (FEC) in lactating vs. dry Jamunapari goats. Parasite infestation showed detrimental effects in animals at their late pregnancy and early lactation due to their priority for mobilizing nutrients for repair, replacement, and reaction to the damage of the gut wall, mucus production, and plasma or whole blood loss (Liu et al., 2003). The traditional control of gastrointestinal parasites is primarily based on the repeated use of chemical anthelmintic drugs. However, the efficacy of these drugs has been reduced nowadays due to the development of anthelmintic resistance in GI parasites (Várady et al., 2011). The use of nutritional supplements as an integrated parasite control mechanism to enhance resiliency and maintain productivity would reduce anthelmintic use in animals (Knox et al., 2006).

The information about the parasite prevalence is crucial to implement any management and control techniques. However, knowledge of the prevalence of GI parasites in lactating Kiko does and their kids stocked in woodlands with supplemental grazing or feedstuffs is limited known. This study tested the hypothesis that the prevalence of GI parasites in lactating does and their kids stocked in woodlands would be the same irrespective of the supplement type. The study objective was to evaluate the prevalence of GI parasites in lactating Kiko does and their kids stocked in woodlands with supplemental grazing or feedstuffs.

Literature review

In the Southeastern U.S., 62% of the total land is covered by woodlands (Bigelow and Borchers, 2017). For instance, woodlands in Alabama cover 23.0 million acres, which is 69% of the total land in the state (Alabama Forestry Commission, 2020). Woodlands can be used for grazing and browsing of small ruminants when properly designed and managed to utilize the understory vegetation in a sustainable manner (U.S. Department of Agriculture Natural Resources Conservation Service [USDA NRCS], 2015). Various forest management practices such as mechanical thinning (shear-rake-pile-bed, subsoiling, and drum chopping), prescribed burning, and chemical application are performed to control the understory vegetation. The cost incurred for vegetation control varies according to the practice used, ranging from $31.12/acre for prescribed burning to $159.75/acre for mechanical methods (Maggard, 2020). The understory vegetation in woodlands can be managed efficiently by integrating small ruminants for grazing (Karki, 2017). Khatri (2016) reported that young Kiko goats consumed 50-75% of understory vegetation available in woodlands up to the height of 5 ft. from the ground surface. A similar result was reported by Bhattrai (2019) with mature Kiko wethers and Katahdin rams as they were found consuming understory vegetation up to the height of 5.2 ft. and 3.7 ft., respectively.

Woodland grazing is an unexplored area, which has a huge potential to uplift the economic, social, and environmental conditions for farmers and landowners (Karki et al., 2021). The woodland grazing system offers landowners multiple benefits like multiple incomes from animals and timbers, supplemental grazing for animals, and reduced cost of animal production (Karki, 2017). Grazing small ruminants in woodlands can provide around $9,947.00 additional cash flow annually from 50 acres than in woodlands without grazing (Karki et al., 2021). Several woodland plant species consist of a good amount of condensed tannins (CT), which have an antiparasitic effect (Min and Hart, 2003). A Few examples of such species are wild plum (*Prunus* spp. L.) (5.7% CT), winged elm (*Ulmus alata* Michx.) (7.7% CT), and sweet gum (*Liquidambar* spp. L.) (3.5% CT) (Karki, 2017). Qokweni et al. (2021) reported that the fecal egg counts of GI nematodes were higher ($p<0.05$) in Xhosa lob-eared does when foraging in grassland as compared to foraging in forestland. Therefore, woodland grazing not only increases the grazing opportunity for small ruminants but also lowers the GI parasite attack.

GI parasites are one of the main problems in goats raised on pastures in the Southeast. The predominant gastrointestinal nematodes (GIN) that infest and lead to clinical disease in goats are *H. contortus*, *Teladorsagia circumcincta*, *Trichostrongylus* spp., *Ostertagia* spp., *Cooperia* spp., and *Oesophagostomum* spp. (Pugh et al., 2021). Among them, *H. contortus*, an abomasal parasite, is the most trouble-causing GI parasite in the Southeastern U.S. due to the warm and moist environmental conditions, which favor the survival and development of the free-living stages of the parasite larvae (Miller, 2018). The most prevalent cestode in sheep and goats belong to the genus *Moniezia* spp. (Miller et al., 2012). GI parasitism often results in anemia, weight loss, weakness, low immunity, decreased reproductive capacity, loss of condition, reduced milk production, and potentially death (Pugh et al., 2021).

Parasite infestation varies according to the physiological stages of animals because of the difference in immunity status. The nutritional demand is high at late gestation, parturition, and early lactation in animals. During the early lactation period, high-producing ewes and goats are unable to consume enough feed to supply the required nutrients (NRC, 2007). Because of inadequate nutrients, many body functions are penalized, mainly immune functions, resulting in a greater establishment, fecundity, and survival of GI parasites within the host (Houdijk, 2012). Poor immune response increases the risk of heavy parasitic load and disease in animals. Animals with adequate nutrition can withstand parasite infestation better than animals on a poor diet (Miller et al., 2012). Therefore, dietary supplementation during parturition and lactation appears to be the most beneficial and effective means to meet animals' nutritional demands and enhance their resilience and resistance against parasites (Miller et al., 2012).

Many studies show that energy and protein supplementations help reduce GI parasitic loads in small ruminants. Energy supplementation (molasses) to Pelibuey sheep reduced the parasitic effect of *H. contortus* (López-Leyva et al., 2020). Gárate-Gallardo et al. (2015) reported that corn supplementation (1.5% body weight) to Criollo goat kids was the best strategy to improve their resilience and resistance against natural infestation of GI nematode that occurred while grazing in tropical forests. Similarly, supplementation of corn at 1.5% of live weight of Pelibuey sheep infested with GI parasites in the silvopastoral system helped improve resilience of their lambs against GI nematodes infestation (Retama-Flores et al., 2012). The author concluded that corn supplementation was an economically viable strategy to control GI nematodes compared to no intervention. Feeding of coastal bermudagrass hay along with corn supplementation increased the live weight ($p<0.01$) and dry matter intake ($p<0.01$) of Spanish wether kids (Walz et al., 2003).

When dietary protein is supplemented to Creole goats, it reduced the fecal egg counts and parasite prolificacy, and increased resistance to *H. contortus* (Cériac et al., 2019). Similarly, protein diet supplementation resulted in low coccidia count in Greek goats (Arsenos et al., 2009). Karki (2017) reported that forages from quality pastures could be used as supplemental grazing for animals in woodlands to improve their performance and resiliency against parasites. Tiwari et al. (2021) found a better performance of Kiko does and Katahdin ewes grazed on legume-grass pastures compared to those grazing sole-grass pastures. These findings show that improvement in the diet of small ruminants, either with supplemental feeds or with quality pastures, can have a significant role in reducing the problem of GI parasites. These parasites are prevalent in small ruminants all over the globe and cause enormous economic loss to producers (Miller et al., 2012). The overall prevalence of GI parasites in Angora goats in Lesotho was 94.7% (Matsepe et al., 2021), in communal goats in South Africa was 37.1% (Mpofu et al., 2020), in coastal savannah zones of Ghana was 90.81% (Squire et al., 2019), and in Black Bengal goats in Bangladesh was 62.1% (Dey et al., 2020). However, information about the prevalence of GI parasites in lactating goats and kids stocked in woodlands is not documented. Knowledge on the prevalence of GI parasites is essential in developing appropriate control strategies, which can reduce loss in the production of small ruminants.

Woodlands present a great potential to expand the grazing and browsing prospects for small ruminants and complement the year-round grazing system. Previous woodland-grazing studies revealed satisfactory performance of mature wethers and rams (Bhattrai, 2019; Paneru, 2020), whereas poor performance of young wethers and ewe lambs warranted supplements (Karki, 2020; Khatri, 2016). These findings indicate that when lactating animals are stocked in woodlands, supplementation would be essential to meet their nutritional demand and keeping them in healthy state. Nevertheless, literature is scant on supplemental strategies for lactating does stocked in woodlands, especially under the production condition of Alabama and the Southeast. Thus, this study was conducted to develop supplementation strategies and assess their association with the prevalence of GI parasites in lactating does and kids stocked in woodlands.

Methods

Study Site

The study was conducted at the Atkins Agroforestry Research and Demonstration Site, Tuskegee University, Tuskegee, Alabama, U.S. (Latitude 32°26'34.0"N, Longitude 85°43'57.4"W). Soil type of the study site consisted of Cowarts loamy sand (60%; slope 5-15%) and Uchee loamy sand (40%; slope 1-5%) ((USDA NRCS, 2019). The site had a humid subtropical climate. The average maximum and minimum temperatures during the study period were 88°F and 71°F, respectively, with an average rainfall of 17 inches. The average maximum and minimum relative humidity were 94% and 55%, respectively. Weather data were downloaded from https://www.wunderground.com/history/monthly/us/al/hope-hull/KMGM/date/2021-10, recorded at the Montgomery regional airport station for Tuskegee Institute, Alabama. This station is located approximately 45 miles west from the study site. The site consisted of six woodland plots and six adjacent silvopasture plots. Each woodland plot contained mixed southern pines (longleaf (*Pinus palustris* Mill.) and loblolly (*Pinus taeda* L.)) of 16 years old and various understory plant species (

Table 1). Each silvopasture plot contained mixed southern pines (longleaf and loblolly) with planted forages like bahiagrass (*Paspalum notatum* Fluegge), cowpeas ((*Vigna unguiculata* (L.) Walp.)) sericea lespedeza ((*Lespedeza cuneata* (Dum. Cours.)

Table 1. List of Major Understory-plant Species in Woodland Plots, July-October 2021, Atkins Agroforestry Research and Demonstration Site, Tuskegee University, Tuskegee, Alabama, U.S.

S.N.	Common Name	Scientific Name
1	American beautyberry	*Callicarpa americana* L.
2	Blackberry	*Rubus* L.
3	Broomsedge	*Andropogon* L.
4	Dogfennel	*Eupatorium capillifolium* Lam.
5	Grapevine	*Vitis rotundifolia* Michx.
6	Greenbrier	*Smilax* L.
7	Hickory	*Carya* spp. Nutt.
8	Panic grass	*Panicum* L.
9	Persimmon	*Diospyros virginiana* L.
10	Southern red oak	*Quercus falcate* Michx.
11	Sumac	*Rhus* spp. L.
12	Sweetgum	*Liquiamber* spp. L.
13	Water oak	*Quercus nigra* L.
14	Wild Plum	*Prunus* spp. L.
15	Winged elm	*Ulmus alata* Michx.
16	Yaupon	*Ilex vomitoria* Aiton.

G. Don)), and crabgrass ((*Digitaria radicosa* (J. Presl) Miq.). Each plot in both systems was one acre, fenced on all four sides, and consisted of a watering facility, mineral feeders, and mobile shelters (Port-A-Hut).

Research Animals

Seventeen Kiko does (26-27 months of age) in their late lactation (2-3 months) 33 kids of age 2-3 months (Male: 15 and Female: 18) were used for the study. They were divided into two uniform groups (Table 2). Animals were grazed in silvopasture plots before they were brought to the woodland study plots. Animals' fecal samples were collected and examined for gastrointestinal parasites before they were stocked in the study plots. Each group was assigned to three woodland plots and rotated among those plots based on the available vegetation throughout the study (89 days, July–October 2021). Group-1 animals were allowed supplemental grazing in silvopasture plots for 3-4 hrs./day and Group-2 animals were supplemented with *ad libitum* coastal bermudagrass hay and cracked corn at the rate of 0.5% of animals' metabolic weight. They were moved to new plots once they consumed 50% of the vegetation available in the initial plot. The utilization and availability of the vegetation in the plots were assessed by visual observation and using photoplots before and after grazing.

FAMACHA Score

FAMACHA score was taken at the beginning after a five-day adjustment period of the study, at the interval of every two weeks during the study, and at the end of the study. FAMACHA score ranges from 1 to 5, 1-2 indicates non-anemic condition, 3 indicates conditional status, and 4 and

Table 2. Initial Parameters of Does and Kids Used in the Woodland Study, July-October 2021, Atkins Agroforestry Research and Demonstration Site, Tuskegee University, Tuskegee, Alabama, U.S.

Variables	Group 1		Group 2	
	Does (9)	Kids (18)	Does (8)	Kids (15)
	LSMean ± SE			
Live wt. (lb.)	92.9 ± 4.69	26.2 ± 1.04	92.7 ± 4.82	26.9 ± 1.92
FAMACHA score	2.6 ± 0.24	2.9 ± 0.16	2.6 ± 0.26	2.7 ± 0.19
BCS	2.3 ± 0.08	2.9 ± 0.08	2.3 ± 0.09	3.0 ± 0.09

5 anemic conditions caused by *H. contortus* in small ruminants. Animals in conditional status require treatment if they are in poor body condition and associated with other health risk factors. Animals with FAMACHA score 4 and 5 require immediate treatment. FAMACHA score was collected by the first author throughout the study from all animals by comparing the color of the conjunctiva on the lower eyelid of both eyes of each animal with the color on the FAMACHA card. Animals having the FAMACHA score 3 or higher were identified for further investigation on GI parasite load.

Fecal Sample Collection and Analysis

Fecal samples were collected from animals having FAMACHA score 3 or above (3-5) by inserting a gloved, lubricated finger into animals' rectum and extracting fecal pellets by using a "come here" motion. Collected samples were analyzed for the type and quantity of parasite eggs using the flotation technique, the major steps of which are presented below (Storey, 2013).

2 g feces and 28 g saturated salt solution mixed well

↓

Mixture strained and allowed to settle for 15 minutes

↓

Supernatant solution taken with a dropper and filled both chambers of McMaster slide

↓

Eggs on all grids in both chambers observed under microscope (10 X objective) and counted

↓

Total eggs from both chambers multiplied by 50 to obtain number of eggs per gram of feces

Animal Treatment

Animals having the fecal egg count above the treatment threshold, as shown in the list below, were treated with appropriate anthelmintic for the type of GI parasite (Albendazole, Moxidectin, Amprolium) (Pugh et al., 2021)

- Lactating does:1000 epg
- Dry does: 2000 epg
- Kids: 500 epg

Data Analysis

Fecal-egg-count data were analyzed using the Wilcoxon rank-sum test in SAS 9.4 because the data were not normally distributed. The confidence level to test the hypothesis was set at 95%.

Percentage and odds ratio were calculated on the prevalence of GI parasites in Microsoft excel®.

Results and Discussion

The hypothesis that the prevalence of GI parasites in lactating does stocked in woodlands would be the same irrespective of supplement type was rejected, as the prevalence of *H. contortus* was lower in Group 1 does (21%) vs. Group 2 does (39%) (

Table 3). Odds ratio for the prevalence of *H. contortus* in Group 2 vs. Group 1 does was 2.4, indicating that the probability of Group 2 does to be infested with *H. contortus* was 2.4 times greater vs. Group-1 does (Table 4). The lower prevalence of *H. contortus* in Group 1 does might be due to better nutrients obtained from quality forages present in silvopasture plots. Agrawal et al. (2015) found a similar prevalence of *H. contortus* in Sirohi goats (47%) (dry, pregnant, and lactating), when supplemented with concentrate ration with mineral mixture and grazed in natural pasture (6 hrs. /day). Tiwari et al. (2021) reported that Kiko does stocked in legume-grass pastures had better FAMACHA score vs. those stocked in sole-grass pastures, indicating better resilience against GI parasites when animals had access to quality pastures.

Table 3. Prevalence of Gastrointestinal Parasites in Doe with Supplemental Grazing (Group 1) and Supplemental Feedstuff (Group 2) in Woodlands, July-October 2021, Atkins Agroforestry Research and Demonstration site, Tuskegee University, Tuskegee, Alabama, U.S.

Gastrointestinal Parasite	Group 1		Group 2	
	Does infested (No.)	Does infested (%)	Does infested (No.)	Does infested (%)
Haemonchus contortus	19	21	31	39
Moniezia spp.	1	1	1	1
Feces not examined for GI parasites (FAMACHA score 1-2)	70	78	48	60
Total	90	100	80	100

Table 4. Odds ratio for *Haemonchus contortus* Infestation for Feedstuff-Supplemented Does (Group 2) vs. Grazing-Supplemented Does (Group 1) in Woodlands, July-October 2021, Atkins Agroforestry Research and Demonstration Site, Tuskegee University, Tuskegee, Alabama, U.S.

Group comparison (Does)	Odds ratio for *Haemonchus contortus* infestation (95% confidence interval)
Group 2 vs. Group 1	2.4 (1.2-4.65)

Unlike parasite prevalence, no difference was found in the number of parasite eggs per gram of feces (epg) between the groups of does. Similar result for the mean epg (620.53) was reported by Chauhan et al. (2003) in Jamunapari does in their late lactation when grazing in pastures containing natural vegetation and supplemented with concentrate mixture. In the current study, the number of does having *H. contortus* load more than the treatment threshold (>1000 epg) was less in Group 1 than in Group 2 (

Table 5). Turner et al. (2017) found a lower number of meat goats with higher load of GI nematodes and reduced dewormer administration when grazing in red clover (*Trifolium pratense* L.) pastures compared to those grazing chicory (*Cichorium intybus* L.) pastures. This indicates that improved pastures would enhance resiliency against GI nematodes in goats. The lower number of does with a high load of *H. contortus* in Group 1 might be due to better nutrients received from quality forages present in silvopastures, resulting in a stronger resiliency against GI nematode parasitism. Cériac et al. (2019) discussed the role of adequate nutrition in increasing resiliency and reducing the load of GI parasites in animals.

Table 5. Load of *Haemonchus contortus* Exceeding the Treatment Threshold in Does with Supplemental Grazing (Group 1) and Supplemental Feedstuff (Group 2) in Woodlands, July-October 2021, Atkins Agroforestry Research and Demonstration Site, Tuskegee University, Tuskegee, Alabama, U.S.

Gastrointestinal Parasites	Group 1			Group 2		
	Does having epg >1000 (No.)	Total observation	Does having epg >1000 (%)	Does having epg >1000 (No.)	Total observation	Does having epg >1000 (%)
Haemonchus contortus	2	108	2	6	96	6

The FAMACHA score was better in supplemental grazing (Group 1) does vs. supplemental feedstuff (Group 2) does (Figure 1) (p<0.05). A previous study also found a better FAMACHA score in Kiko does when stocked in legume-grass vs. sole-grass pastures (Tiwari et al., 2021). Worku et al. (2017) reported a better FAMACHA score in goats when grazing in cowpea pastures vs. pearl-millet pastures. The better FAMACHA score in Group 1 does found in the current study could be due to better nutrition obtained from the supplemental grazing vs. Group 2 does.

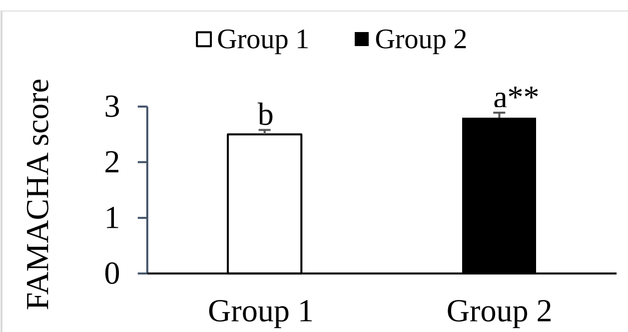

Figure 1. FAMACHA Score of Grazing-Supplemented (Group 1) Does vs. Feedstuff-Supplemented (Group 2) Does in Woodlands, July-October 2021, Atkins Agroforestry Research and Demonstration Site, Tuskegee University, Tuskegee, Alabama, U.S. (**p < 0.05).

The study hypothesis that the prevalence of GI parasites in kids stocked in woodlands would be the same irrespective of the supplement type was rejected since the prevalence of *H. contortus*, *Moniezia* spp., and coccidia differed between Group 1 and Group 2 kids. Prevalence of *H. contortus* was higher in Group 1 kids than in Group 2 kids (Table 6). The odds ratio for the prevalence of *H. contortus* in Group 1 was 1.5 (Table 7). This indicates that the Group 1 kids were 1.5 times more likely to be infected with *H. contortus* than Group 2 kids. Kids in Group 1 had access to planted pastures whereas kids in Group 2 spent more time browsing in woodlands. Since the chance of consuming the infective parasitic larva was higher from grazing vs. browsing (Karki, 2017), the grazing environment might have been the reason for the higher prevalence of *H. contortus* in supplemental-grazing (Group 1) kids compared to Group 2 kids. Similar results were reported by Qokweni et al. (2021) in Xhosa lob-eared goats with less epg when browsing in forestland than when grazing in grasslands ($p<0.05$).

Table 6. Prevalence of Gastrointestinal Parasites in Kids with Supplemental Grazing (Group 1) and Supplemental Feedstuff (Group 2) in Woodlands, July-October 2021, Atkins Agroforestry Research and Demonstration Site, Tuskegee University, Tuskegee, Alabama, U.S.

Gastrointestinal Parasites	Group 1			Group 2		
	Kids infested (No.)	Total observation	Infestation (%)	Kids infested (No.)	Total observation	Infestation (%)
Haemonchus contortus	43	126	34	27	105	26
Moniezia spp.	29	126	23	18	105	42
Coccidia	17	126	13	20	105	19

Table 7. Odds Ratio for *Haemonchus contortus*, *Moniezia* spp., and Coccidia Infestation for Feedstuff-Supplemented Kids (Group 1) and Grazing-Supplemented Kids (Group 2) in Woodland, July-October 2021, Atkins Agroforestry Research and Demonstration Site, Tuskegee University, Tuskegee, Alabama, U.S.

Group comparison (kids)	Odds ratio for parasite infestation		
	Haemonchus contortus	*Moniezia* spp.	Coccidia
	Odds ratio (95% confidence interval)		
Group 1 vs Group 2	1.5 (0.95-2.25)	1.4 (0.7-2.8)	
Group 2 vs Group 1			1.5 (0.74-3.06)

Coccidia epg was higher in Group 2 kids vs. Group 1 kids ($p < 0.05$) (Table 8). The reason behind the higher counts of coccidia in Group 2 kids versus Group 1 kids could be due to different immunological competence that might have resulted from different supplement types. Group 2 kids did not have enough opportunity to eat the supplemented corn, as does accessed and finished it quickly after supplementation. In Group 1, does and kids had equal access to forage in silvopasture plots. In a study with crossbred kids, Faizal and Rajapakse (2001) observed 9728 oocysts per gram (opg) of feces when no supplement was provided and allowed to graze in dry area of Sri Lanka. In the current study, the number of kids having the *H. contortus* load exceeding the treatment threshold (>500 epg) was higher in Group 1 than Group 2 kids (Table 9).

Table 8. Mean Score of Eggs of Gastrointestinal Parasite Present Per Gram of Feces (EPG) in Kids from Group 1 and Group 2 in Woodlands, July-October 2021, Atkins Agroforestry Research and

Demonstration Site, Tuskegee University, Tuskegee, Alabama, U.S. (**$p < 0.05$).

Gastrointestinal Parasites	Group 1	Group 2
	Mean Score	
Haemonchus contortus	42.08	37.10
Moniezia spp.	41.86	37.40
Coccidia	35.09^{b}	46.83^{a**}

Table 9. Eggs of Gastrointestinal Parasite Present Per Gram of Feces (EPG) Exceeding the Treatment Threshold in Kids with Supplemental Grazing (Group 1) and Supplemental Feedstuff (Group 2) in Woodlands, July-October 2021, Atkins Agroforestry Research and Demonstration Site, Tuskegee University, Tuskegee, Alabama, U.S.

Gastrointestinal Parasites	Group 1			Group 2		
	Kids with >500 epg (No.)	Total observation	Kids with >500 epg (%)	Kids with >500 epg (No.)	Total observation	Kids with >500 epg (%)
Haemonchus contortus	26	126	21	14	105	13
Moniezia spp.	10	126	8	6	105	6
Coccidia	7	126	6	9	105	9

Conclusion

The type of supplements showed a significant effect on the prevalence of GI parasites in lactating Kiko does and their kids stocked in woodlands. Does that had access to supplemental grazing in silvopastures (3-4 hours/day) showed a lower prevalence of *Haemonchus contortus* and better FAMACHA score compared to does supplemented with *ad lib.* hay and corn (0.5% of metabolic weight). However, kids in supplemental-grazing group showed a higher prevalence of *H. contortus* and *Moniezia* spp. compared to kids in the supplemental-feedstuff group. Nevertheless, coccidia count was less in supplemental-grazing compared to kids in the supplemental-feedstuff group. Findings of this study indicate that supplementing lactating does stocked in woodlands with quality pastures is a better option for enhancing resiliency against GI parasites compared to the supplemental feedstuffs used in this study. For supplementing young kids that are stocked with their mothers, creep feeding is recommended so that they can have a reasonable portion to fulfill their nutritional requirements.

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