Small Ruminant Research 136 (2016) 1–6

Contents lists available at ScienceDirect

Small Ruminant Research

journal homepage: www.elsevier.com/locate/smallrumres

Investigation of possible pumpkin seeds and ginger effects on gastrointestinal nematode infection indicators in meat goat kids and lambs

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ARTICLE INFO

Article history:
Received 28 April 2015
Received in revised form
21 December 2015
Accepted 26 December 2015
Available online 31 December 2015

Keywords:
Internal parasites
Meat goats
Lambs
Pumpkin
Ginger

ABSTRACT

In four experiments, 77 naturally-infected Boer crossbred kids and 28 artificially-inoculated Katahdin lambs were used to evaluate the effect of pumpkin seeds (Exp 1; 21 kids), ginger or pumpkin seed drench (Exp 2; 30 kids) and pumpkin seed oil (Exp 3 and 4: 28 lambs and 26 kids, respectively) on gastrointestinal nematode (GIN) indicators. In all experiments, kids and lambs were placed in individual pens and received pre-weighed rations of a commercially pelleted meat goat or sheep diet daily. In Exp 1, kids were supplemented with ground pumpkin seeds (PUM; $n = 10$) mixed into feed daily at a rate of 5 g/kg body weight (BW) or were not supplemented (CON; $n = 11$) for 21 days. In Exp 2, kids were orally drenched with water (CON; $n = 10$), 5 g pumpkin seed/kg BW (PUM; $n = 10$) or 3 g ginger/kg BW (GIR; $n = 10$) every other day for 42 days. In Exp 3, lambs were orally drenched with 2 ml/kg water (CON; $n = 7$), 2.0 ml/kg BW pumpkin seed oil once every 7 days (PUM1; $n = 10$), or 2.0 ml/kg BW pumpkin seed oil daily for 3 out of every 7 days (PUM2; $n = 11$) for 28 days. In Exp 4, kids were orally drenched with 2 ml/kg water (CON; $n = 13$), or 2.0 ml/kg BW pumpkin seed oil (PUM; $n = 13$) every other day for 35 days. In all experiments, BW, daily feed intake and blood and fecal samples were collected every 7 days. All animals in Exp 2 were harvested at a USDA-inspected abattoir and abomasal and small intestinal contents were collected for total worm counts. The FEC were similar for treatments in all experiments. Treatment influenced PCV ($P < 0.05$) only in Exp 1 and 4. In Exp 2, at harvest, there was a tendency ($P = 0.08$) for CON animals to have a higher number of total GIN than GIR-treated animals, but PUM-treated animals were intermediate. BW were similar for treatments in Exp 1, 2 and 3 while CON animals in Exp 4 had a greater BW than PUM-treated animals on day 7 only and were similar thereafter (treatment by day interaction, $P < 0.05$). In these studies, pumpkin and ginger treatments administered were not effective in reducing FEC in meat goat kids or lambs.

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1. Introduction

A major hurdle in the U.S. small ruminant industry is production loss due to gastrointestinal nematodes (GIN), particularly the blood sucking abomasal GIN, *Haemonchus contortus* (Miller and Craig, 1996). Parasite infections, a major health problem in small ruminants, can hinder production due to reduced weight gains and increased mortality (Kaplan et al., 2007). The most common method used to control GIN infection is anthelmintic drug treatment. However, anthelmintic overuse and misuse has led to an increased prevalence of resistance in sheep and goat GIN (Mortensen et al.,

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http://dx.doi.org/10.1016/j.smallrumres.2015.12.036
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2003; Crook et al., 2010). Anthelmintic resistance is now a global problem (Coles, 2005; Kaplan et al., 2007; Howell et al., 2008; Crook et al., 2010), and has been reported for all three major classes of anthelmintics (Terrill et al., 2001; Howell et al., 2008; Crook et al., 2010).

Because GIN resistance to anthelmintics in small ruminants is well documented, alternative methods of control have been investigated. For instance, the seeds of squash (*Cucurbita moschata*), pumpkins (*Cucurbita maxima* and *pepo*) and many other vine crops are believed to contain a deworming compound called cucurbitacin and have been studied in lambs (Strickland et al., 2009) with varying results. In addition, ginger (*Zingiber officinale*) has also been used as an anthelmintic purge for cattle, horses (Duval, 1997) and lambs (Iqbal et al., 2006). Even though the effectiveness of these natural products is primarily anecdotal (Githiori et al., 2006), the increasing incidence of anthelmintic resistance as well as the popularity of organically produced animals has led to renewed interest in alternative parasite control strategies. It was therefore the objective of these experiments to determine the efficacy of fresh pumpkin seeds, a pumpkin seed drench, pumpkin seed oil or a ginger drench as natural means of parasite control in meat goat kids and lambs.

2. Materials and methods

2.1. Animals and procedures

All animal-related procedures were conducted in compliance with Delaware State University Institutional Animal Care and Use Committee guidelines. All animals were placed in individual 1.2 m × 1.2 m pens on solid concrete floors (day 0) and received pre-weighed rations of a commercially pelleted 15% CP meat goat feed (Southern States Inc., Richmond, VA) in Exp 1, 2 and 4 or a pelleted 16% CP sheep feed (Southern States Inc., Richmond, VA) in Exp 3 at approximately 3% of their BW daily but adjusted daily so that feed was supplied *ad libitum*. Water was supplied *ad libitum* and orts were measured weekly in all experiments except Experiment 3. In all experiments, BW was measured and fecal and blood samples were collected to determine FEC and PCV every 7 days. Feces were also pooled for coproculture in Exp 1, 2 and 4 to determine GIN genera according to Peña et al. (2002). Fecal egg counts were determined using the Modified McMasters technique (Whitlock, 1948). If PCV was <15% in any experiment, animals were orally treated with moxidectin (0.2 mg/kg for lambs and 2 times the label sheep dose for goats) and removed from the study.

2.2. Experiment 1

Twenty-one naturally-infected female and castrated male Boer/Spanish crossbred meat goat kids, averaging 185.1 ± 1.9 days of age were randomly assigned to one of two treatments after accounting for initial FEC and BW. Goat kids were supplemented with ground pumpkin seeds (*Cucurbita pepo;* PUM; $n = 10$) mixed into the feed at a rate of 5 g/kg BW or were not supplemented (CON; $n = 11$) daily for 21 days. One PUM-treated animal was dewormed and removed from this experiment on day 7 because of PCV below 15%.

2.3. Experiment 2

Thirty naturally-infected female and castrated male Boer/Kiko crossbred meat goat kids with a mean age of 144.4 ± 1.1 days were randomly assigned to one of three treatments based on initial FEC and BW. Kids were orally administered treatments of water (CON; $n = 10$), 5 g pumpkin (*C. pepo)* seed/kg BW (PUM; $n = 10$) or 3 g ginger (*Z. officinale*)/kg BW drench (GIR; $n = 10$) every other day for 42 days. Pumpkins (*C. pepo*) were purchased from Fifer Orchard in Dover, DE and seeds were removed, rinsed and air-dried for use in this study. The amounts of pumpkin seeds (5 g/kg BW) and ginger (3 g/kg BW) used was determined from previous studies evaluating the anthelmintic properties of these products (Strickland et al., 2009; Iqbal et al., 2006; Practical Farmers of Iowa, 2004). The pumpkin seed drench was prepared from an anecdotal method for the treatment of GIN in sheep by adding 500–600 g of ground pumpkin seeds in 3 l of water, simmering over low heat for 30 min, sieving to extract as much juice as possible after cooling, and then reducing over low heat to 150–200 ml (Duval, 1997) such that each animal in this treatment received a dosage of approximately 5 g pumpkin seed extract/kg BW. To have sufficient treatment, two batches were prepared at each dosing. The ginger drench was prepared by grinding 300–500 g of ginger in 100 ml of water, sieving and administering orally such that each animal in this treatment received a specific ml dosage of ginger extract/kg BW (determined such that each animal received an amount of extract equivalent to that produced from 3 g of ginger/kg BW), with doses determined weekly based on sampling day BW. Eight animals were dewormed and removed from this experiment on days 14 (3CON and 4 GIR) and 28 (1 GIR) because PCV declined below 15%.

At the end of the study, all remaining animals were harvested at a USDA-inspected abattoir. The abomasum and small intestine were tied off and removed, stored in zippered bags on ice until content collection the same day. Contents were collected into 3000 ml tap water, mixed well and two 150 ml aliquots were collected, mixed with 100 ml of 10% formalin and stored until GIN counting at Louisiana State University. Abomasal and small intestinal worm counts were conducted according to procedures described by Shaik et al. (2006).

2.4. Experiment 3

Twenty-eight female and castrated male Katahdin lambs at approximately 300 days of age were dewormed orally with moxidectin (0.2 mg/kg) and levamisole (6 mg/kg) and kept in a barn with concrete floors, limited straw bedding and no access to pasture to minimize possible re-infection. Following a 21-day dewormer withdrawal period, lambs were artificially inoculated twice, two days apart, with a 2 ml larval inoculation containing approximately 750 L3 *H. contortus*. Treatments were administered approximately 45 days after inoculation. Treatments consisted of one dose of a commercially available pumpkin (*C. maxima*) seed oil (PUM; 100% Certified Organic Pumpkin Seed Oil, Swanson Health Products, Fargo, ND) and water (CON) over 28 days. Lambs treated with pumpkin seed oil were further divided into two groups. In the PUM1 group lambs were administered the pumpkin seed oil drenched at a rate of 2.0 ml/kg (equivalent to 5 g pumpkin seeds/kg BW; $n = 10$) once every week (7 days) or water on days when PUM2 lambs were treated. Lambs in the PUM2 group were administered the pumpkin seed oil drenched at the rate of 2.0 ml/kg (equivalent to 5 g pumpkin seeds/kg BW; $n = 11$) divided equally over 3 doses in one week (3 out of 7 days) such that their total dose was equivalent to the dose that was given in the PUM1 group. In the CON ($n = 7$) group, lambs were drenched with water on the same day as the PUM2 group. One lamb from the PUM1 group was removed and another from the PUM2 group was dewormed and removed on day 21 due to PCV <15%.

2.5. Experiment 4

Twenty-six naturally-infected female and castrated male Boer/Kiko crossbred meat goat kids at 166.4 ± 1.0 days of age were placed in one of two treatments based on initial BW and FEC. Treatments consisted of one dose of a commercially available pumpkin seed oil (PUM; 100% Certified Organic Pumpkin Seed Oil, Swanson

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