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The effectiveness of copper oxide wire particles as an anthelmintic in pregnant ewes and safety to offspring

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Abstract

The objective of the experiment was to determine the effectiveness of copper oxide wire particles (COWP) in pregnant ewes and safety to lambs. COWP have been used recently as an anthelmintic in small ruminants to overcome problems associated with nematode resistance to chemical dewormers. Doses of COWP (≤4 g) have been used in lambs without clinical signs of copper toxicity. Use in pregnant ewes has not been examined. Mature Katahdin ewes were administered 0 ($n = 14$), 2 ($n = 15$), or 4 ($n = 15$) g of COWP 33 ± 1.6 days before lambing in late March 2004. Fecal egg counts (FEC) and blood packed cell volume (PCV) were determined between Days 0 (day of COWP administration) and 35. Lambs were weighed within 24 h after birth, at 30 and 60 days of age, and in mid-September (∼120 days of age). Blood was collected from lambs within 24 h after birth and at 30 days of age for determination of the activity of the liver enzyme, aspartate aminotransferase (AST) in plasma. Within 7 days after COWP administration, FEC decreased by 1308 and 511 eggs/g (epg) in the 2 and 4 g groups, respectively, compared with an increase of 996 epg in the control group ($P < 0.02$). PCV was similar among groups between Days 0 and 35. Lamb plasma AST activity at birth increased with increasing dose of COWP in dams ($P < 0.001$). Plasma AST activity at 30 days of age was similar for lambs from ewes treated with 0 and 2 g COWP, but was slightly greater in lambs from ewes treated with 4 g COWP ($P < 0.02$). Birth weights decreased with increasing COWP ($P < 0.003$). By 30 (COWP × birth type, $P < 0.02$) and 60 (COWP × birth type, $P < 0.02$) days of age, weight of multiple-born lambs decreased with increasing COWP, while weight of single-born lambs was similar among treatments. In mid-September (∼120 days of age) weights of multiple-born lambs from ewes treated with 4 g COWP tended to be lightest compared with lambs from ewes treated with 0 or 2 g COWP or single-born lambs ($P < 0.09$). Lamb survival to 30, 60, or 120 days of age was not affected by COWP treatment to ewes. Administration of 4 g COWP to late pregnant ewes may negatively impact multiple-born offspring, but the 2 g appears to be safe for production.

Keywords: Copper oxide; Ewes; *Haemonchus contortus*; Pregnancy

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1. Introduction

Options for gastrointestinal parasite control for small ruminants are limited because of the rapidly developing resistance of nematodes to chemical dewormers (Miller and Craig, 1996; Zajac and Gipson, 2000; Terrill et al., 2001; Mortensen et al., 2003). Other means of parasite control have become necessary. Copper oxide wire particles (COWP) have been used in lambs to reduce infection with *Haemonchus contortus* (Bang et al., 1990; Knox, 2002; Burke et al., 2004). No clinical signs of copper toxicity have been reported when administering less than 6 g of COWP to lambs or 10 g COWP to ewes although liver concentrations of copper were elevated in ewes (Suttle, 1987). There was a linear increase with dose of COWP (0–6 g) in concentrations of copper in the liver, but all levels were considered within a safe zone (Puls, 1988; Gartrell and Beetson, 2004). Liveweight gains were similar (Burke et al., 2004) or elevated, likely in response to decreased parasite infection (Langlands et al., 1983; Knox, 2002).

COWP have been used to treat sheep with copper deficiency without any clinical signs of copper toxicity at doses lower than 10 g (Dewey, 1977; Whitelaw et al., 1980; Suttle, 1981, 1987). Maternal copper from COWP can be transported to the fetus of pregnant ewes (Langlands et al., 1982) and milk of lactating ewes (Whitelaw et al., 1980). Fetal and conceptus concentrations of copper increased in ewes treated with COWP in early pregnancy (Langlands et al., 1982).

Growth of lambs or potential toxicity to lambs from COWP-treated ewes considered to be normocupretic and use of COWP in mature sheep for parasite control has not been examined. The objective of the current experiment was to examine the efficiency of COWP in reducing a mixed parasite infection in mature pregnant ewes and determine whether there were any adverse effects on their offspring.

2. Materials and methods

Katahdin ewes between 2 and 4 years of age were bred in December 2003 to one of two Katahdin rams. Ewes were diagnosed for pregnancy using transrectal ultrasonography (Aloka SSD 500 V ultrasound scanner equipped with a 7.5 MHz linear array prostate transducer; Aloka Co. Ltd., Japan). In late March pregnant ewes were randomly assigned to receive 0 ($n = 14$), 2 ($n = 15$), or 4 ($n = 15$) g COWP (Copasure; Animax Veterinary Technology, UK) in a gelatin capsule administered per os 33 ± 1.6 days before lambing. Only four ewes had been dewormed with moxidectin (Cydectin®; 0.2 mg/kg oral administration) between December and March prior to COWP treatment. Ewes grazed bermudagrass (*Cynodon dactylon*) overseeded with rye (*Secale cereale*) as a single group throughout the experiment except for supplementation with bermudagrass hay while lambing in the barn. Ewes had continuous access to trace mineralized salt devoid of copper (Land O'Lakes Sheep and Goat Mineral, Shoreview, MN) and water. Ewes were supplemented with 500 g corn/soybean (4.4:1.0) 19 days before COWP administration until 28 days post-lambing. Ewes lambed within a 30 day period between mid-April and mid-May.

Fecal egg counts (FEC), as determined by a modified McMaster technique (Whitlock, 1948), and blood packed cell volume (PCV) were determined between Days 0 (day of COWP administration) and 35. FEC and PCV of lambs was determined 7 days after weaning. Body weight of ewes was determined post-lambing. Lambs were weighed within 24 h after birth, at 30 and 60 days of age, and in mid-September (~120 days of age). Blood was collected from lambs within 24 h after birth and at 30 days of age for determination of the liver enzyme, aspartate aminotransferase in plasma (AST; Booneville Community Hospital, Booneville, AR). Plasma AST activity is a measurement of liver copper status of lambs (Buckley and Tait, 1981). Between birth and 30 days of age three lambs died (one multiple from a control ewe was laid on and two multiple-born from 2 g COWP-treated ewes; one was mis-grouped and the other died from unknown causes) and five lambs were orphaned because dams had mastitis with little or no milk (three multiple-born from a control ewe and two multiple-born from a 2 g COWP-treated ewe). Lambs were weaned at approximately 60 days of age. At that time 11 lighter weight lambs (2 g COWP, $n = 7$; 4 g COWP, $n = 4$; all multiple-born) were culled from flock. It is common practice for this flock to cull the bottom 15% in terms of live weight. Three lambs died after weaning (one single- and one multiple-weaned from control ewes and one multiple-weaned from a 4 g COWP-treated ewe; two died from haemonchosis and one died for unknown reasons).