MONENSIN AGAINST BOVINE COCCIDIOSIS

SYNOPSIS. Monensin, an anticoxidial antibiotic, was incorporated into pelleted feed and given to 10-week-old Holstein-Friesian calves at 0.25 mg/kg, 1.0 mg/kg, or 2.0 mg/kg of body weight. Inoculated calves were inoculated by drenching with 500,000 sporulated oocysts of *Eimeria bovis*. Other calves served as inoculated or uninoculated controls. Observations were recorded on oocyst discharge in the feces, clinical signs, weight gain, food consumption, hemoglobin, packed cell volume, total serum protein, sodium and potassium content of the serum, and differential white cell counts.

Calves in the inoculated control group developed severe infections, discharged large numbers of oocysts, developed clinical signs and 1 of 5 died. Uninoculated, untreated control calves were essentially free of coccidia. A few calves in the groups which received monensin developed light infections but none of them had clinical signs of coccidiosis. Calves which received the highest and the lowest dosages of monensin gained weight less rapidly than did the uninoculated controls or the animals which received monensin at 1.0 mg/kg of body weight. Inoculated control calves with severe infections had reduced food intake and a significant reduction in weight which was not regained during the experimental period.

The only other significant change in any of the parameters measured was a reduction in the total serum protein of inoculated, nonmedicated control calves. The level returned to normal 5 weeks after clinical signs first appeared.

Index Key Words: *Eimeria bovis*; coccidiosis in Holstein-Friesian calves; antibiotic monensin; prevention of coccidiosis by.

ANTICOCCIDIAL feed additives generally have not been used for the treatment or prevention of coccidiosis in cattle. Medication has usually been on an individual basis with drugs being given in drinking water, by dose syringe, or, more rarely, by sprinkling the drug on loose feed. Several compounds have been used in different ways for the control of bovine coccidiosis (3, 5-7). A newcomer among the anticoxidial drugs is monensin, an antibiotic now being used to control poultry coccidia (8, 9). The antibiotic is also effective against hepatic coccidia of rabbits (4). The present report describes the effectiveness of monensin against *Eimeria bovis* of cattle when incorporated in feed.

MATERIALS AND METHODS

Twenty-five 1 to 5-day-old Holstein-Friesian calves were obtained and separated randomly into 5 groups of 5 each until they were adjusted to the new environment and feed. After 6 weeks, the groups of calves were re-examined and adjusted to make the groups as nearly equal in weight, size, conformity, etc., as possible.

Each calf in 4 of the 5 groups was inoculated by drenching with 500,000 sporulated oocysts; the 5th group was held as an uninoculated control group. The inoculum consisted of *E. bovis* (99%) and *Eimeria ellipsoidalis* (1%) in water. Calves in group 1, in addition to the oocysts, were given monensin in pelleted feed (0.0015%) so that a dosage of 0.25 mg/kg of body weight was fed in the morning and evening for 33 days. Calves in groups 2 and 3 also were inoculated with the oocysts but were given monensin in feed at concentrations of 0.006% or 0.024% to supply dosages of 1.0 mg/kg or 4.0 mg/kg body weight. Two days after starting the calves on the medicated feed it was found that those in group 3 refused the pelleted feed that contained the highest concentration of monensin (0.024%). Because of this the medicated feed was mixed with an equal quantity of unmedicated feed so that the new mixture had a concentration of 0.012% monensin and was fed to obtain a dosage of 2.0 mg/kg twice daily starting on the day of inoculation. The calves in group 4 were nontreated uninoculated controls. Feed was prepared by incorporating monensin in a highly palatable, complete feed, the mixture containing 0.0015%, 0.006%, or 0.012% monensin. Pellets were prepared and given to calves in quantities to meet dosage requirements. Pellets without monensin were prepared for the controls.

Calves in groups 1, 2, and 3 were started on medicated feed 3 days before inoculation and continued for 30 postinoculation days. As the calves gained in weight, the food intake was adjusted so that they ate sufficient feed each day to maintain the proper level of medication throughout the experimental period.

Observations made on calves during the experiment included

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the following: fecal examinations for the presence of oocysts; observation of clinical signs (diarrhea, blood, tissue, tenesmus); feed consumption; weights; blood hemoglobin and packed cell volume; differential blood cells; total serum protein; and serum Na and K levels.

### RESULTS

It can be seen in Fig. 1 that the average discharge of oocysts and clinical signs in calves of groups 1, 2, and 3 (calves given monensin) was low or nonexistent. Calves in group 4...
Fig. 4. The blood hemoglobin content in Holstein-Friesian calves inoculated with *E. bovis* and treated with monensin in pelleted feed.

(non-treated, inoculated controls) became relatively severely infected, developed severe clinical signs, and discharged a moderate number of oocysts for 7-10 days (1 calf in this group died of coccidiosis). Two calves in the non-treated, uninoculated control group (group 5) discharged a few oocysts in the 1st part of the experiment.

The average weekly weights of the calves during the experimental period are shown in Fig. 2. These results indicate a reduced rate of gain associated with the presence of monensin in feed at the lowest and at the highest concentrations. There was no difference in the rate of gain between the uninoculated control group and group 2 (1.0 mg/kg of monensin) calves. At the end of the experimental period calves in group 4 (the inoculated controls) had the smallest weight gains, averaging 25 or 30 lb less than the uninfected controls or group 2 animals. Calves in group 3, which received the highest level of medication, had slightly larger weight gains than those of group 4.

Some erratic behavior in feed consumption was observed which was associated with the amount of monensin in the pellets (Fig. 3). Group 3 calves had a marked decline in the average consumption beginning shortly after they were started on the pelleted feed which contained the high level of monensin (0.024%). With a subsequent reduction of the monensin (0.012%) concentration, by mixing medicated with unmedicated feed to furnish a dosage of 2.0 mg/kg, the level of feed consumption increased, but did not return to the level of the other animals during the experimental period. Group 4 calves had a marked reduction in feed consumption when clinical signs of coccidiosis began to appear 2½ weeks postinoculation. The differences in rates of feed consumption between the uninoculated

Fig. 5. The packed blood cell volume in Holstein-Friesian calves inoculated with *E. bovis* and treated with monensin in pelleted feed.
control calves (group 5) and those in groups 1 and 2, which received lower concentrations of monensin, were negligible. There was no evidence of toxic reaction in any of the calves at any time.

Measurements of the hemoglobin and packed cell volume from calves in all of the groups failed to reveal a consistent pattern of change, attributable either to coccidiosis or to the presence of the antibiotic, in the averages of any of the groups (Figs. 4, 5). Similarly, there were no consistent alterations in the generally erratic leucocyte counts of any of the calves.

A reduction in the total protein of the blood sera of calves in the infected group 4, at the time when they had severe clinical signs, is evident from Fig. 6. There was also a slight reduction in the total serum protein of group 1 calves (monensin at 0.25 mg/kg body weight). The latter may have been associated with low grade coccidial infections in these calves. This does not seem likely, however, because changes in serum protein level usually occur only in association with severe clinical signs. In this group the reduction in total protein was observed almost 2 weeks later than in the severely affected calves of group 4. The averages of the other groups were similar.

There were no significant differences (P > 95%) in the Na or K levels of the blood serum in calves given monensin at any of the 3 concentrations or in the uninoculated or inoculated control animals (Fig. 7).

DISCUSSION

The results of this experiment indicate that monensin, incorporated in pelleted feed at the concentrations used, protected Holstein-Friesian calves from severe clinical coccidiosis caused by Eimeria bovis.

Treatment of calves with monensin in pelleted feed at 1.0 mg/kg gave somewhat better results than the 0.25 mg/kg treatment. In the latter, all the animals became lightly infected while only 1 became lightly infected in the former group. The response of calves in group 3 is less well defined because these animals did not feed readily on the pellets. Three of 5 calves in this group became lightly infected at various times without any reference to the time of inoculation. Even after concentration of monensin in the feed was changed from 0.024 to 0.012%, by mixing medicated with unmedicated pellets, the question remained as to whether calves received medication at the right time and/or quantity to prevent infections. Infections may have occurred on a day the calves failed to eat enough medicated pellets to obtain the desired dosage. Calves in this group consumed the pelleted feed initially containing 0.024% of monensin reluctantly and this may have influenced their susceptibility to the coccidia. All 5 calves in the experimentally infected, non-medicated control group 4 discharged oocysts, some more than others, and more severe clinical signs developed in some animals than in others.

The hemoglobin, packed cell volume and leucocyte ratios, as well as the Na and K content of blood serum were not significantly different (P > 95%) in any of the groups of calves regardless of the treatment regimen. No previous data are available that correlate such measurements in calves. It was found previously that pronounced changes in serum Na or K occur in calves moribund with severe coccidiosis (2). The serum total protein content was reduced in the inoculated, unmedicated calves of group 4 beginning when clinical signs appeared. This is similar to a typical change reported earlier (1).

Unfortunately, it is not evident from this experiment what stages of Eimeria bovis are affected by monensin. Shumard & Callender (9) have shown that the drug is effective against sporozoites of Eimeria tenella. In other studies this antibiotic has been shown to be highly effective against infections of Eimeria stiedai in the livers of rabbits (4), apparently affecting the sporozoites as they move into the liver.
Fig. 7. The Na and K serum content in calves inoculated with E. bovis and treated with monensin in pelleted feed.
REFERENCES


References to the Use of Cultures of Algae and Protozoa

A sample survey of the literature on algae and protozoa has confirmed the impression that authors do not always give adequate reference to the strains used in work involving cultures. The sample used was the 1971 issues of 14 journals taken at this establishment which publish original work on algae and protozoa. Papers dealing with fossils, larger seaweeds, and organisms not so far cultured, were excluded.

Minimum adequate reference is considered to be the designation of the culture together with, where appropriate, indication of the source collection e.g. CCAP 211/8d or Göttingen 11/6. A more complete reference would give also the name of the isolator and the date of isolation, but this information usually is available in the List published by the collection.

It is evident from the survey that over 3/4 (153 out of 204) of the authors used cultures when this was possible. It is evident also that well over half of the users (89 out of 153) gave inadequate or no reference to the cultures used. This is most unsatisfactory, especially when one considers the rigid insistence by authors and editors on proper bibliographic references.

References to specific names and a collection e.g. "Chlamydomonas globosa from CCAP" are not satisfactory as there may be now, or in the future, more than 1 strain fitting that description. Also, taxonomic names are liable to revision while strain designation should be immutable. References such as "Tetrahymena pyriformis 'W' Strain" are inadequate without mention of the source. It has been shown recently by isozymal tests that strains of this species from different sources but with the same designation, may differ, while differently designated strains may be identical. The cause of this confusion presumably lies in mislabelling and failure to record the origin of stocks used. In 1 paper there was a serious orthographic error in a strain designation.

Wherever possible, cultures of new taxa or new strains used in important research should be deposited in at least one major collection. It is also of great value to a culture collection to receive reprints of work done with its cultures. —E. A. GEORGE, Director, The Culture Centre of Algae & Protozoa, 36 Storey's Way, Cambridge CB3 ODT, England.

Note from the Publisher

The delay in the publication of the November, 1972 issue, volume 19 (4), was caused by circumstances beyond our control or that of the editor. We wish to apologize to the subscribers and readers for this delay which we are certain will not recur in the future.—Allen Press.