The use of Bacitracin in the Prevention and Treatment of Experimentally-induced Necrotic Enteritis in the Chicken

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INTRODUCTION

Necrotic enteritis is a widespread and important disease of broiler chickens. There have been several reports recently on the reproduction of the disease using broth cultures of *Clostridium perfringens* Type A strains (5, 7) or bacteria-free crude toxins (1). Deliberate super-infection with coccidia also has been used to aid experimental production of the disease with *C. perfringens* (2). The purpose of the work reported here was to study the effect of zinc bacitracin in prevention and treatment of necrotic enteritis.

MATERIALS AND METHODS

Isolate

An isolate of Type A *Clostridium perfringens*, designated KV-3, was used throughout the trials. It was isolated from a field case of necrotic enteritis and obtained from Dr. R. B. Truscott. Cooked meat medium[1] was used to maintain stock cultures (7).

Chickens

Commerical one day old mixed-sex broiler chickens were brooded in isolation facilities until they were two weeks old; they were then caged in groups of similar size in a separate room for the trials. All trials were carried out in one room and were carried out on four occasions.

Feed

A previously described method of feeding was followed (7). Birds were fed a 50:50 mixture of turkey starter[2] and fish meal[3] until 13 days of age. On day 14 birds were starved for 20 hours before being fed a chick starter.[4] In some cases this was inoculated with a broth culture of *C. perfringens*. Fresh inoculated feed was prepared in two portions, eight hours apart.

Inoculated Feed

Cooked meat medium stock culture was added as a 3% inoculum to thioglycollate broth[5] enriched with 1% soluble starch.[6] Broth cultures were incubated at 37°C. Sufficient quantities were used at 15 and 23 hours incubation to prepare inoculated feed twice daily, the ratio of feed-to-broth being 1:1.5 (w/v). Any feed not eaten the next day was discarded and containers cleaned. Birds were fed infected feed for five days (day 15 through day 19). The feeding experiment was terminated on day 20 when survivors were killed and their intestinal tracts examined. Dead birds were similarly examined. Lesions in the intestinal tract were graded as follows: 0, no gross lesions; 1+, thin-walled or friable small intestine; 2+, focal necrosis or ulceration; 3+, larger patches of necrosis; 4+, severe, extensive necrosis typical of field cases.

Zinc Bacitracin

Zinc bacitracin[7] was administered through the drinking water which was available at all times. The chickens were divided into six groups and the experimental plan is shown in Table I.

RESULTS

Results from the four trials were similar and were therefore combined, as shown in Table II. Necrotic enteritis was controlled by all treatments used. A small proportion of birds in three of the trials showed minor intestinal changes attributable to coccidiosis. Food intake and weight gain by birds in group A was markedly reduced. Three birds in group A showed extensive necrotic foci in the liver from which *C. perfringens* were recovered in large numbers.

DISCUSSION

Necrotic enteritis was successfully produced in birds of Group A, in which mortality was 12.4% and lesions of varying severity were produced in 66.5% of birds surviving in this group. Bacitracin at 100 mg/gallon of water effectively prevented the disease (group B) and at 200 and 400 mg/gal-

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[1]Difco Laboratories, Detroit, Michigan.

[2]Master Feed Krums, Maple Leaf Mills Ltd., Toronto, Ontario.

[3]Martin Feed Mills Ltd., Elmira, Ontario.

[4]Master Chick Starter Krums, Maple Leaf Mills Ltd., Toronto, Ontario.

[5]Fluid thioglycollate medium USP, BBL, Cockeysville, Maryland.

[6]Fisher Scientific Co., Fair Lawn, New Jersey.

[7]Baciferm soluble-50, IMC Chemical Group, Inc., Terre Haute, Indiana.

TABLE I

PLAN OF EXPERIMENT TO DETERMINE THE EFFECT OF BACITRACIN ON NECROTIC ENTERITIS IN CHICKENS

Group	A	B	C	D	E	F
No. birds (4 trials)	194	194	194	196	174	170
Challenge with *C. perfringens*	+	+	+	+	—	—
Bacitracin (mg/gal water)[a]	—	100	200	400	400	—
Administration (until death)	—	72 hours pre-challenge	24 hours post-challenge	24 hours post-challenge	24 hours post-challenge	—

[a]Imperial gallon.

TABLE II

EFFECT OF BACITRACIN ON MORTALITY AND LESIONS OF NECROTIC ENTERITIS

Trial Group	Number of Birds	Deaths	Lesion scores of survivors				
			0	1+	2+	3+	4+
A	194	24[a]	57	6	32	57	18
B	194	6[b]	176	6	4	2	—
C	194	6[b]	186	—	—	2	—
D	196	3[b]	193	—	—	—	—
E	174	1[b]	173	—	—	—	—
F	170	1[b]	169	—	—	—	—

[a]Necrotic enteritis.
[b]Not necrotic enteritis.

lon was effective in treating the experimental disease (groups C, D).

The postchallenge administration of bacitracin to groups C and D may have acted in part by preventing rather than treating the disease. No evidence was obtained that birds were sick prior to the administration of bacitracin. However, deaths of birds in group A started approximately 48 hours after challenge suggesting that lesions associated with the experimental disease had a rapid onset in challenged animals.

Preliminary trials, the results of which are not reported, were carried out to determine the best means of producing the disease. Experience gained from these trials, which initially were disappointing, showed that the most important factor in the production of the experimental disease was the presentation to young birds of a continuous challenge of heavily infected feed, prepared fresh twice daily. A proportion of the birds in some trials showed mild coccidial lesions; coccidia were acquired following starvation and moving to the room where the birds were challenged and were thought to have no significance in the reproduction of the disease. A coccidial predisposition to the disease, however, has been suggested from studies of field cases (3) and has been shown experimentally (2).

The strain of *C. perfringens* used to produce the disease may be important but there is no information available on this point. Most isolates from field cases of necrotic enteritis are Type A organisms (4) and are therefore of environmental origin, but Type C organisms also appear to have been implicated (6). The pathogenic factor common to these isolates is probably the ability to produce large amounts of alpha toxin.

SUMMARY

Inclusion of zinc bacitracin at 200 and 400 mg/gallon of drinking water was effective in treating experimentally-induced necrotic enteritis in the chicken; incorporation of 100 mg/gallon prevented its occurrence. Factors affecting the successful reproduction of the disease are discussed.

RÉSUMÉ

L'incorporation de bacitracine à base de zinc dans l'eau de boisson, à raison de 200 et 400 mg/gallon, permit de traiter efficacement l'entérite nécrotique expérimentale du poulet. L'addition de seulement 100 mg de cet antibiotique par gallon d'eau, empêcha l'éclosion de la maladie. Les auteurs commentent les facteurs qui contribuent à reproduire avec succès cette maladie.

ACKNOWLEDGMENTS

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ANALYSE DE VOLUME/ BOOK REVIEW

Les Oligo-éléments. M. Lamand. Publié par Dalloz, Paris. 1976. 78 pages. Prix $15.50.

Dans cette plaquette, l'auteur, jouissant d'une renommée européenne dans le domaine des oligo-éléments, réussit une excellente synthèse sur le sujet. Dans une première partie, les oligo-éléments discutés sont ceux dont l'importance est bien connue chez le ruminant, soit le fer, le cuivre, le cobalt, le zinc, le manganèse, le sélénium, l'iode et le molybdène. Pour chacun de ces éléments, l'auteur retrace l'historique, indique les sources et les teneurs des principaux nutriments. Il décrit ensuite les fonctions biochimiques et physiologiques en ajoutant les signes cliniques de la carence et le diagnostic analytique. Le texte est illustré de tableaux expressifs et de photos couleurs tout aussi explicites. À la fin de chaque chapitre, le lecteur trouve une bibliographie qui, si elle n'est pas exhaustive, n'en permet pas moins de retrouver les auteurs classiques de la discipline.

Dans une deuxième partie, l'auteur étudie les interférences et les liaisons entre les minéraux, interrelations qui ont causé tant de mauvaises interprétations! Il termine par un chapitre de considérations pratiques: diagnostic biochimique, traitement, prévention, méthodes de dosage du Cu et du Zn, prélèvement, conservation et expédition des échantillons pour obtenir les meilleures chances de succès lors de l'analyse de laboratoire.

En résumé, cette plaquette imprimée sur de l'excellent papier glacé et recouverte d'une jaquette cartonnée très résistante est à conseiller à tous ceux qui désirent faire le point dans ce domaine, qu'ils soient médecins vétérinaires praticiens à l'emploi de l'État, chercheurs ou étudiants. Fait à souligner, le texte est composé avec un caractère d'imprimerie agréable à lire. Le seul reproche qu'on puisse faire à cet ouvrage, est de ne s'intéresser qu'aux ruminants. Il est à souhaiter que d'autres mises à jour viendront combler cette carence.

In this brochure, the author carries out the best synthesis on micro-minerals actually available. In the first part, he covers the most important micro-minerals in the ruminant ration: iron, copper, cobalt, zinc, manganese, selenium, iodine and molybdenum. The historical background, the sources and the levels in the most important nutrients of each element are discussed. Furthermore, the author describes their biochemical and physiological functions and enumerates the clinical signs in cases of deficiencies, with the biochemical diagnosis.

In the second part, the author studies the interferences and the interactions between the minerals. The text is concluded by a practical chapter on biochemical diagnosis, treatment, collection, preservation and expedition of blood samples.

The text is well-rendered with clear tables and descriptive color photographs. This brochure is recommended to anyone interested in the up to date knowledge on this subject, from the veterinary student to the practitioner. *D. Barrette*.