Br. vet. J. (1989). **145**, 170

EFFECT OF ANTIBIOTIC TREATMENT OF YOUNG CALVES ON GLUCOSE ABSORPTION AND SOME PLASMA COMPONENTS

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SUMMARY

Oral treatment of 10–15 day-old calves with either chloramphenicol (55 mg/kg body wt) or tetracycline (11 mg/kg body wt) did not induce diarrhoea. Treatment caused significant elevation of plasma Na^+, K^+ and total protein. Calves treated with chloramphenicol showed retarded glucose absorption from the gut.

INTRODUCTION

In a survey of Michigan dairy farms, Oxender, Newman & Morrow (1973) found that mortality of calves was significantly higher where antibiotics were used prophylactically and therapeutically than in herds where they were not used. Subsequently it was shown that orally administered antibiotics, at the recommended dosages, cause severe diarrhoea that is fequently fatal (Huffman *et al.*, 1981). Recently Rollin *et al.* (1986) have attempted to elucidate some of the metabolic changes during antibiotic-induced diarrhoea. The present experiments were undertaken with the same objective in the context of the Turkish dairy industry.

MATERIALS AND METHODS

Twenty-one 10–15-day-old healthy Montafon calves supplied by Konya Agricultural Research Centre, were divided into three equal groups:

Group 1: untreated control group;
Group 2: treated with tetracycline (Sigma Chemical Co., St. Louis, MO, USA) (11 mg/kg body wt) orally twice daily for 5 days.
Group 3: treated with chloramphenicol (Sigma Chemical Co., St. Louis, MO, USA) (55 mg/kg body wt) orally twice daily for 5 days.

The dams were fed with clover, hay and concentrated ration before and during the experiment.

Tetracycline and chloramphenicol in pure form were diluted with water (2%).

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Following overnight fasting in group 1 and on completion of treatment in groups 2 and 3, the following tests were performed; oral glucose tolerance test (OGTT), packed cell volume (PCV), plasma sodium and potassium using flame photometry and plasma total protein using Boehringer Test Kits (Biochemica-Boehringer, Lewes, Sussex, UK). OGTT involved giving 2 g of 10% glucose solution per kg body weight and collecting jugular vein blood into heparinized tubes at 0, 30, 60, 120 and 180 minutes post-infusion. Plasma glucose was measured in these samples using Menagent Test Kits (Menagent Test Kits, A. Nenarono, D.I.V. Diagnostici, V.I.A. Sette Samti, 3, 50 131, Firenze, Italy). Data were analysed using the analysis of variance (Snedecor, 1957) and least significant differences were calculated (Steele & Torrie, 1980).

RESULTS

In the present study, neither antibiotic treatment regimen resulted in diarrhoea. However, significant changes in some of the parameters measured were found.

The outcome of oral glucose tolerance tests in antibiotic treated and control groups is shown in Fig. 1. It is apparent from these results that chloramphenicol treatment resulted in a significant delay in glucose absorption from the gut and gave elevated plasma glucose levels 180 minutes after oral administration.

Table I shows the variation in plasma sodium, potassium and total protein between the control and the two treatment groups. Treatment with both antibiotics led to a significant increase in plasma sodium, potassium and total protein levels. No significant changes in PCV were observed.

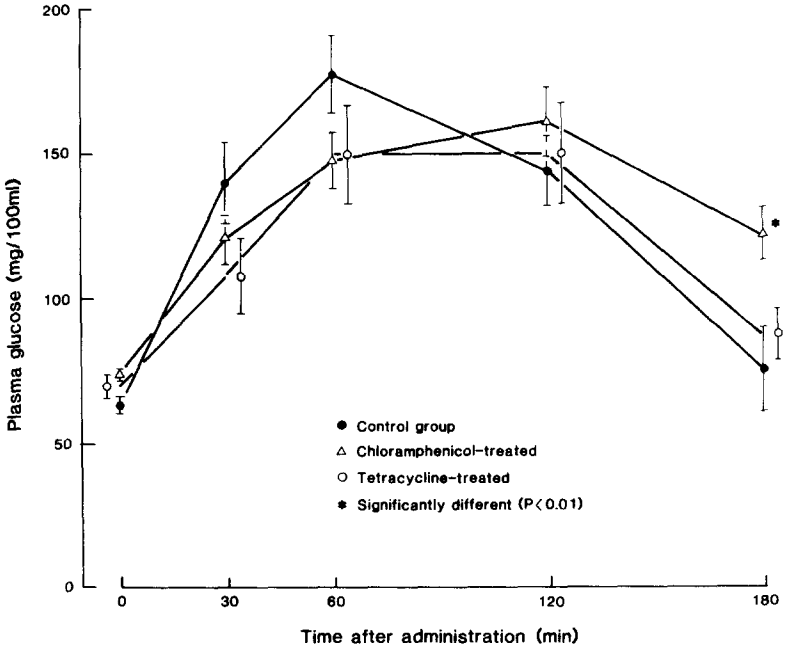

Fig. 1. Plasma glucose concentration at various intervals after oral glucose administration (OGTT) to control and treated calves.

Table I
Mean (±SE) plasma Na^+, K^+ and total protein concentrations in the control and experimental calves

	Groups		
	Control	*Chloramphenicol treated*	*Tetracycline treated*
Na^+ (mmol/l)	102·91 ± 1·04	116·45* ± 1·33	116·02* ± 0·95
K^+ (mmol/l)	4·87 ± 0·13	6·77* ± 0·18	6·51* ± 0·09
Total protein (mg/dl)	3·51 ± 0·20	4·67* ± 0·18	4·52* ± 0·10

*Significantly different from control group ($P < 0·01$).

DISCUSSION

Other workers have found that oral administration of chloramphenicol (Huffman *et al.*, 1981; Rollin *et al.*, 1986) or tetracycline (Rollin *et al.*, 1986) at the doses used above induced severe diarrhoea. In the present work no diarrhoea was found in any of the normal calves treated with antibiotics. The rate of removal of chloramphenicol from the plasma of neonatal calves increases markedly with age (Reiche, Mulling & Frey, 1980). However, the slightly older age of the calves used in the present experiment is unlikely to be the explanation for this absence of diarrhoea, as Huffman *et al.* (1981) used calves 7–9 days old and found a higher incidence of diarrhoea than that shown by the 3–4-days-old calves of Rollin and co-workers (1986). It is more probable that the discrepancy is either a breed difference or due to antibiotics incorporated in the maternal food, crossing the placenta (Reiche *et al.*, 1980) and causing some form of tolerance to develop in the offspring. The occurrence of diarrhoea after antibiotic administration to healthy mature horses was ascribed to the accompanying rapid increase in *Clostridium* organisms in the gastrointestinal tract (Andersson *et al.*, 1971). However, after antibiotic treatment of healthy calves Rollin *et al.* (1986) failed to find any increase in intestinal organisms.

In spite of the absence of diarrhoea in the current experiment the antibiotics used caused significant changes which, had the animal shown diarrhoeic symptoms, might have been considered secondary to the diarrhoea. The marked increase in plasma K^+ was not found by Rollin *et al.* (1986) after induction of diarrhoea with both chloramphenicol and tetracycline; however, both Tennant's and Case's group (Tennant, Harold & Reina-Guerra, 1972; Case, Phillips & Cleek, 1980) reported elevated levels of plasma K^+ in calves with spontaneous and oral pathogen-induced diarrhoea respectively.

Elevated plasma protein levels seem to be a common finding in diarrhoeic calves (Tennant *et al.*, 1972; Case *et al.*, 1980) and due to the accompanying increase in PCV are usually considered to be due to fluid loss. Rollin *et al.* (1986) found no increase in plasma protein in calves with tetracycline-induced diarrhoea and only a slight increase in more severely diarrhoeic calves treated with chloramphenicol. Neither group showed an increased PCV. This absence of marked changes in plasma protein was ascribed by Rollin *et al.* (1986) to their animals showing only mild diarrhoea which was more severe in the case of the chloramphenicol-treated calves. The elevated plasma protein levels in

the absence of diarrhoea and changes in PCV would in the present experiment indicate a more fundamental role for changes in plasma protein in these events.

Elevated plasma Na^+ levels due to antibiotic treatment have not been noted by other workers (Rollin *et al.*, 1986). The increased plasma Na^+ in the present experiment may be responsible for the absence of diarrhoea.

In contrast to tetracycline, chloramphenicol administration retarded the rate of glucose transfer across the gastrointestinal epithelium in the present experiment. Rollin *et al.* (1986) also found changes in glucose transfer following chloramphenicol but not after tetracycline treatment. However, their chloramphenicol treated calves had elevated plasma glucose levels at the start of the OGTT (119 mg/dl versus 88 mg/dl for controls), a finding not confirmed by us. Diarrhoea itself does not cause elevated glucose levels (Lewis, Phillips & Elliott, 1975). In spite of the elevated intitial plasma glucose levels found by Rollin in chloramphenicol-treated calves their data also show a decreased rate of glucose transfer, illustrated by plasma glucose levels after OGTT not having returned to initial levels by 240 min. Chloramphenicol treatment thus modifies the rate of transport of glucose across the gut while tetracycline treatment does not.

ACKNOWLEDGEMENTS

We are grateful to the University of Selçuk for financial support and to Konya Agricultural Research Centre for supplying the animals. We are also grateful to Dr K. P. Bland, Royal (Dick) School of Veterinary Studies, Edinburgh, for assistance with the manuscript.

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(Accepted for publication 27 June 1988)