The first efficacious *Cryptosporidium* vaccine protecting newborn calves

Marina Timmermans, Dianne Schroer, Willem Hubers, David Hermans, Geert Vertenten, Mark van Roosmalen

INTRODUCTION

Neonatal calf diarrhea (NCD) is the leading cause of morbidity and mortality worldwide.

Cryptosporidium is one of the major pathogens associated with NCD and causes severe diarrhea in newborn calves[1-6]. Currently, no effective vaccine is available for the treatment or prevention of cryptosporidiosis.

A published known important antigen involved in the prevention of *C. parvum* infection is the gp40 or gp60 antigen[7,8], supporting the development of a recombinant gp40-based vaccine.

OBJECTIVE

The objective of this study was to investigate if an experimental *Cryptosporidium* vaccine could provide protection against an experimental *Cryptosporidium parvum* challenge in neonatal calves by passive immunization.

MATERIALS AND METHODS

Healthy pregnant heifers (n=8) were vaccinated in the last trimester of pregnancy with the *Cryptosporidium* vaccine and Bovilis® Rotavec® Corona (test group). A control group (n=8) was included that was only vaccinated with Bovilis® Rotavec® Corona. After calving, colostrum was collected and stored frozen.

Viable newborn calves (8 per group) received at least 3L colostrum within 4h after birth and were challenged with *Cryptosporidium parvum* oocysts 2-4 hours later. The next day the calves were fed milk replacer supplemented with 1L colostrum and on day 3, 4 and 5 the calves received milk replacer with 0.5L colostrum.

The calves received randomly control colostrum or test colostrum. Calves were monitored twice daily for 14 days on vital signs (general impression, appetite, skin tent, dehydration, appearance, and stool consistency). Fecal samples were taken when diarrhea became prominent and tested for presence of enteric pathogens (rotavirus, coronavirus, *Cryptosporidium, E. coli*) using the BIO K 288™ - Rainbow Calf Scours 4 test (Bio-X Diagnostics, Belgium). All parameters were statistically evaluated with p=0.05.

This study showed efficacy of an experimental vaccine *Cryptosporidum parvum* challenged calves fed with colostrum from vaccinated heifers

RESULTS

Watery diarrhoea was most frequently reported in the control group calves (53.1% vs 25.6%) and resulted in 2 dead calves in the control group (Fig. 1). *Cryptosporidium* parasites were detected on average 1 day later for the test group calves compared to the control group calves.

The clinical scores of the test calves were in general better compared to the calves in the control group with a maximum health score of 4 in the test group calves and 7.5 in the control group calves (Fig. 2).

The mean total diarrhoea and health score in the control group calves (resp 27.5 and 71) was significantly higher than the test group calves (resp 12.6 and 28) (Fig. 3).

FIGURE 1. Graphical depiction of the average diarrhea score over time

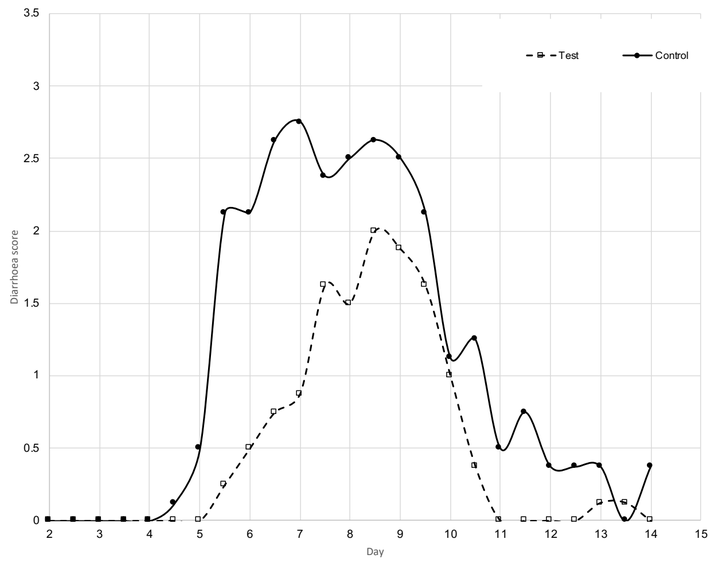


FIGURE 2. Graphical depiction of the average clinical score over time

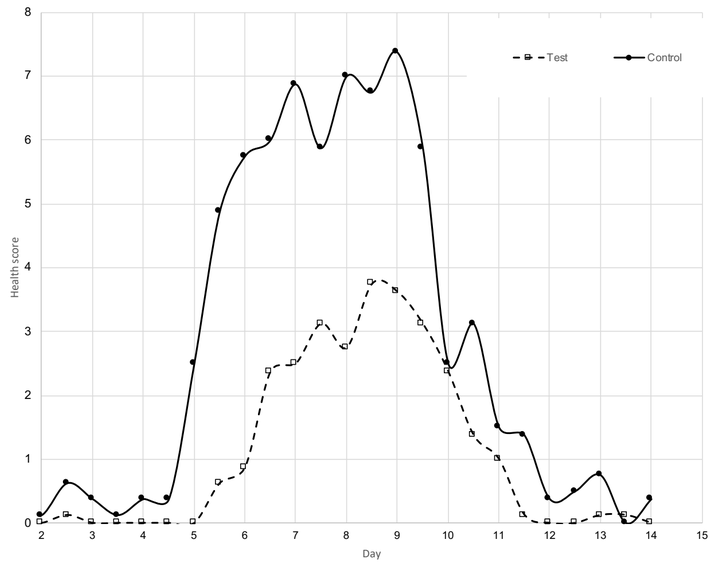
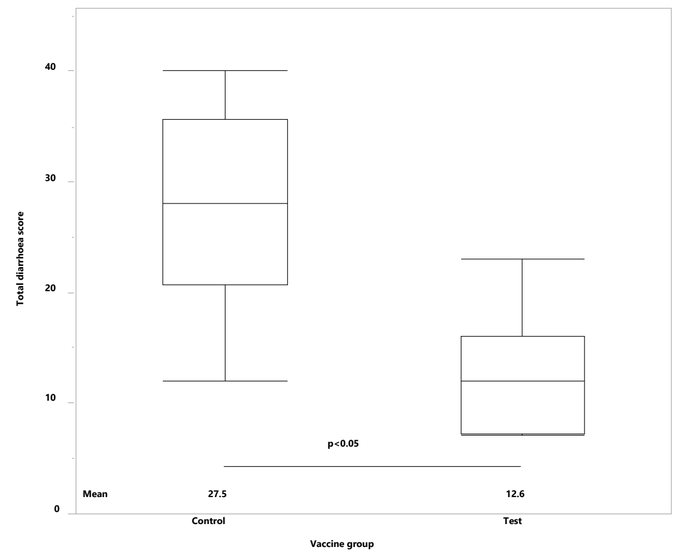
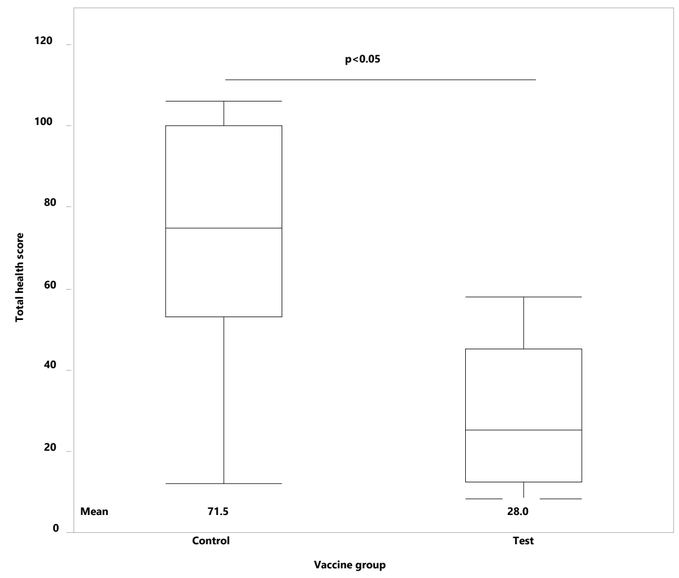


FIGURE 3. Boxplot of the summarized diarrhoea (top) and health (bottom) scores per animal per test group





REFERENCES

1. Millemann Y. Diagnosis of neonatal calf diarrhoea. Rev Med Vet (Toulouse) 2009;160:404–9.
2. Mead JR. Prospects for immunotherapy and vaccines against Cryptosporidium. Hum Vaccines Immunother 2014;10:1505–13. ***https://doi.org/10.4161/hv.28485***.
3. Delafosse A, Chartier C, Dupuy MCC, Dumoulin M, Pors I, Paraud C. *Cryptosporidium parvum* infection and associated risk factors in dairy calves in western France. Prev Vet Med 2015;118:406–12.
4. Pinto P, Ribeiro CA, Hoque S, Hammouma O, Leruste H, Détriché S, *et al*. Cross-border investigations on the prevalence and transmission dynamics of cryptosporidium species in dairy cattle farms in western mainland europe. Microorg anisms 2021;9:2394. ***https://doi.org/10.3390/microorganisms9112394***.
5. Thomson S, Hamilton CA, Hope JC, Katzer F, Mabbott NA, Morrison LJ, *et al*. Bovine cryptosporidiosis: impact, host-parasite interaction and control strategies. Vet Res 2017;48:42. ***https://doi.org/10.1186/s13567-017-0447-0***.
6. Brook E, Hart CA, French N, Christley R. Prevalence and risk factors for Cryptosporidium spp. infection in young calves. Vet Parasitol 2008;152:46–52. ***https://doi.org/10.1016/J.VETPAR.2007.12.003***.
7. Smith RP, Clifton-Hadley FA, Cheney T, Giles M. Prevalence and molecular typing of *Cryptosporidium* in dairy cattle in England and Wales and examination of potential on-farm transmission routes. Vet Parasitol 2014;204:111–9. ***https://doi.org/10.1016/j.vetpar.2014.05.022***.
8. Priest JW, Li A, Khan M, Arrowood MJ, Lammie PJ, Ong CS, *et al*. Enzyme immunoassay detection of antigen-specific immunoglobulin G antibodies in longitudinal serum samples from patients with cryptosporidiosis. Clin Diagn Lab Immunol 2001;8:415–23. ***https://doi.org/10.1128/CDLI.8.2.415-423.2001***.

AUTHORS' AFFILIATION

MSD Animal Health, Boxmeer.

MSD Animal Health