First Defense®

RESEARCH REPORT

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In Vitro Neutralization of Calf-Guard® with Colostral Whey: Using Lab Results to Understand the Outcome at the Calf-Level

QUICK READ

- Calf diarrhea (scours), especially that caused by pathogens such as rotavirus and coronavirus, is a major cause of disease in unweaned dairy and beef calves. While most herds strive for good colostrum management, those practices could still fall short of providing full immune protection. For additional scour protection some herds provide an oral scour vaccine at birth. Calf-Guard® is a commonly used, modified-live oral scour vaccine against bovine rotavirus and coronavirus.
- Colostrum samples from across the U.S. were analyzed for their ability to inactivate (neutralize) the vaccine (Calf-Guard®) *in vitro*. In all samples from both vaccinated and unvaccinated cows, Calf-Guard® was 100% neutralized by maternal antibodies present in colostrum, when that colostrum was immediately added to the sample. When colostrum was withheld from samples for 30 minutes, then added, Calf-Guard® was neutralized in samples from both vaccinated and non-vaccinated cows by 93.9% and 92.5%, respectively.
- These results demonstrate that a majority of the Calf-Guard® vaccine was neutralized, and thereby rendered ineffective as a vaccine, which is a trend likely mirrored in the calf. **Therefore, the usage of an oral scour vaccine such as Calf-Guard®, is detrimental to a newborn calf's overall immune status, and has a negative economic benefit to the producer.**

Background

Calf diarrhea is a major cause of disease and economic loss among unweaned calves in the United States[1]. The 2007 National Animal Health Monitoring Service (NAHMS) summary reported U.S. dairy calf mortality was estimated to be 57% due to diarrhea, of which coronavirus and rotavirus are major causes[2]. Beef calf mortality, while a slightly different type of system, follows similar trends. In both dairy and beef operations, a variety of techniques are employed to combat the effects and spread of diarrheal disease including vaccination, biosecurity, and colostrum management. Yet, as an industry, significant reductions in scour related illnesses have not been achieved over the years. One of the vaccinations often administered to calves just after birth is Calf-Guard®, an oral modified-live rota-coronavirus vaccine. However, the effectiveness of this vaccination is often in question, especially in the face of high antibody levels calves receive from colostrum.

Study Objective

The goal of this study was to investigate Calf-Guard® vaccine viability in the presence of colostral samples from herds using ScourGuard® versus no dam-level scour vaccine. This *in vitro* mechanism mirrors the physiological processes occurring in the calf at the time of birth, colostrum administration, and vaccination.

Study Design

Colostrum samples were collected from four geographical regions: NY/PA, TX, IN/OH and CA. Each region provided eight colostrum samples; four from individual cows vaccinated with ScourGuard® and four individual cow samples from herds not using dam-level scour vaccines. Experiments were conducted at RTI, LLC (Brookings, SD) using an *in vitro* cell-based assay. All samples were processed via two-step centrifugation with the middle (whey-based) fraction collected and frozen at -20°C until tested.

As an indication of vaccine neutralization, coronavirus titer was determined by serial titration of reconstituted vaccine on MDBK mammalian monolayer of cells. Coronavirus neutralization was assessed by infecting the cells using Calf-Guard® in the absence or presence of colostral whey-based samples. A reduction in the number of foci relative to the control was considered indicative of neutralization. Two experimental designs were utilized *in vitro* to replicate the use of Calf-Guard® in the field. In the first design processed samples at one dilution (17 replicates) were immediately added to vaccine and subsequently plated on the monolayer of cells, mimicking the on-farm delivery of colostrum and Calf-Guard® together. To mimic on-farm colostrum delay, diluted samples were added to the cells 30 minutes after the addition of vaccine. The percent of coronavirus titer reduction was directly compared to the "positive control" wells containing Calf-Guard® only.

Results

Sample results were averaged across all regions and sample type. Results are presented in Table 1.

TABLE 1 Calf-Guard® Neutralization

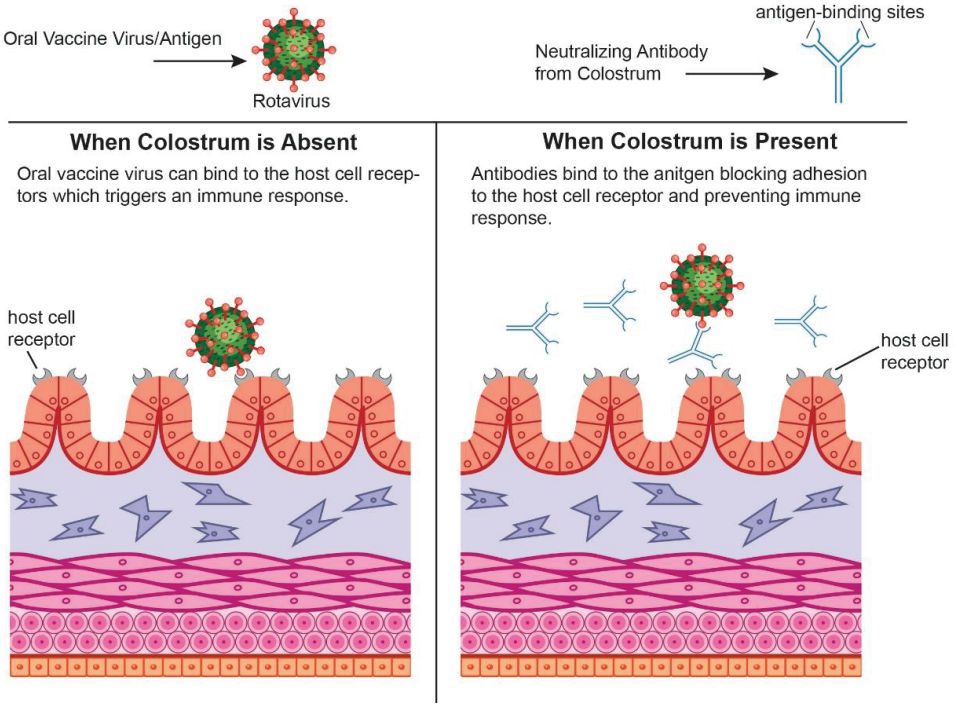
	Calf-Guard® administered with Colostrum	Calf-Guard® administered and colostrum withheld for 30 min*
Vaccinated Dam	100%	93.9%
Non-Vaccinated Dam	100%	92.5%

*P<0.001

- In samples with immediate colostrum addition, both ScourGuard® vaccinated and non-vaccinated dams had 100% neutralization of coronavirus in Calf-Guard® vaccine, leaving no corona-vaccine antigen left for monolayer infection and rendering the vaccine virus ineffective.
- When colostrum was withheld from samples for 30 minutes, there was a statistically significant difference between vaccinated and non-vaccinated dams. Colostrum from vaccinated dams demonstrated 93.9% vaccine neutralization, consequently rendering only 6.1% Calf-Guard® vaccine available for monolayer infection. Colostrum from non-vaccinated dams evidenced 92.5% vaccine neutralization, leaving only 7.5% Calf-Guard® vaccine available for monolayer infection. This type of antibody binding is illustrated in Figure 1.

Despite these differences, whether colostrum was withheld for thirty minutes or not, the overall effect is that an **oral scour vaccine (Calf-Guard®) is inactivated and rendered ineffective in the presence of colostrum.**

FIG 1 Within the Intestine



Conclusions

- The importance of excellent colostral management cannot be overemphasized. In the bulk of U.S. beef and dairy herds, colostrum is administered as soon as possible after birth to ensure optimal antibody transfer. In particular, most beef calves have access, and do indeed nurse colostrum immediately. If calves are receiving proper antibody transfer through colostrum, an oral scour vaccine such as Calf-Guard® is neutralized and made worthless in the face of those antibodies.
- The Calf-Guard® vaccine label does not indicate the importance of delaying colostrum to ensure the modified-live vaccine is not inactivated, and producers should not omit or delay colostrum administration as a general practice. Although it is possible Calf-Guard® could be helpful in those calves with inadequate colostrum and/or diminished immune status, careful consideration should be taken for its use. For the most part, Calf-Guard® is being largely neutralized when calves are born into herds with typical common-sense colostrum management programs, providing the $3.50-$4.50 per calf product cost investment little, if any, return.
- Additionally, as maternal antibodies from colostrum are taken up with binding to the vaccine virus, they are less available to combat naturally occurring pathogens that calves will surely encounter. Consequently, there is an overall lower circulating level of antibodies, making the calf's immune system function at a suboptimal level.

Therefore, it is logical to maximize calf health and economic benefits by NOT using an oral calf vaccine, such as Calf-Guard®. Producers should look to enhance colostrum administration, herd health, and sanitation in an effort to ward against newborn calf disease, rather than place their faith in a one-time vaccination. Alternatives to oral modified-live scour vaccines, such as the First Defense® line of USDA approved antibody products, should be considered to enhance immunity for newborn calves, especially for those at high risk for infection.

SOURCES

Calf-Guard ® and ScourGuard® are registered trademark of Zoetis Services LLC.

1. USDA. Dairy 2007 Part II: Changes in the U.S. Dairy Cattle industry, 1991-2007. Fort Collins: USDA-APHIS-VS, CEAH; 2008. pp. 57–61.
2. Yong-il Cho, Kyoung-Jin Yoon. An overview of calf diarrhea—infectious etiology, diagnosis, and intervention. J Vet Sci. 2014 Mar; 15(1): 1-17)

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