Control of Footrot and Liver Abscesses with FUSOGARD™: A New *Fusobacterium necrophorum* Bacterin for Cattle

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Summary

Footrot Trials

Three separate safety trials and a comprehensive efficacy trial were conducted to demonstrate the safety and efficacy of FUSOGARD™ *Fusobacterium necrophorum* bacterin (ImmTech Biologics, Bucyrus, KS) for the aid in control of Footrot.

A trial was conducted to demonstrate the efficacy of *Fusobacterium necrophorum* bacterin against Footrot in calves when challenged with a virulent heterologous isolate of the bacteria. Calves were vaccinated twice, at day 0 and day 21. Each calf was challenged 14 days after the second vaccination with 0.5 mL of the virulent bacteria in the interdigital area near the coronary band. All control calves developed severe lameness, joint/soft tissue swelling and abscessation during the 19 days post-challenge. Three of the vaccinated animals developed mild lameness.

Liver Abscess Trials

Four separate field trials were conducted to evaluate the efficacy of FUSOGARD™ *Fusobacterium necrophorum* bacterin in reducing the number and size of liver abscesses in feedlot cattle. The animals were vaccinated twice with the second vaccination at 60 days. The animals were fed with typical high-concentrate diets and received Tylan® in their feed during the last 100-150 days in the feedlot. The cattle were slaughtered in commercial packing plants with the liver from each animal carefully checked by the local meat inspector. Each liver was then scored according to the commonly accepted Elanco scoring system: normal, A-, A and A+. The most severely abscessed livers were scored as A+.

In all four trials, the liver condemnation rate was significantly lower in the vaccinated groups when compared to the non-vaccinated controls. More notable was the significantly lower A+ abscessed livers in the vaccinated groups. Liver abscesses in category A- or A are considered to have no measurable effect on rate of gain, feed efficiency or carcass weight. Abscesses classified as A+ significantly reduce feed intake (up to 13.8%), weight gain (up to 11.4%), feed efficiency (up to 29.5%) and carcass weight (up to 4.6%).[6] The results of these four trials demonstrate the efficacy of *Fusobacterium necrophorum* in reducing the severity of liver abscesses in feedlot cattle.

Safety Trials

In three separate safety trials (a total of 597 head of cattle in three separate locations) *Fusobacterium necrophorum* bacterin was administered twice with the second vaccination given three weeks after the initial dose. Within 3-5 days of vaccination, each calf was examined and palpated at the injection site for swelling, pain or evidence of formation of a sterile or contaminated abscess. Overall, less than 5% of the vaccinated calves had small nodules. These were completely resolved by 10 days post-vaccination.

Introduction

Footrot or interdigital necrobacillosis is an acute, painful, necrotizing condition involving the interdigital skin and usually spreads to deeper structures of the foot. The infection usually occurs due to trauma to the foot in a wet, slushy and dirty environment. The bacterium, *Fusobacterium necrophorum* may enter the soft tissue of the interdigital space, establish itself and produce toxin, and cause tissue damage, inflammation and abscesses. The animal may become lame in one or more legs, and at times, effects may be so severe that they will go off feed. Although the disease is rarely fatal, the economic loss from treatment and decrease in weight gains can be substantial.

Liver abscesses in feedlot cattle continue to represent a serious economic concern, with incidences in slaughter cattle averaging 12% to 32%. Liver abscesses are a significant economic liability throughout the beef production chain, with abscesses being the major cause of liver condemnation in the United States.[3] But the greatest economic effect of liver abscesses is related to reduced animal performance and carcass yield. Cattle with abscessed livers have reduced feed intake, reduced weight gain, decreased feed efficiency and decreased carcass dressings percentages. The effect of abscesses on performance has been reported as high as an 11% decrease in average daily gains and a decrease in feed efficiency of as much as 9.7%.[1]

The endemic incidence of liver abscesses in feedlot cattle has been widely reported.[4,5] The incidence is related to the common practice of feeding a high-concentrate diet the last 100-150 days in commercial feedlots. Liver abscesses in feedlot cattle are caused by *Fusobacterium necrophorum,*[2] a gram-negative, strictly anaerobic, non-motile, rod-shaped bacterium. Feeding a high-concentrate diet results in acidosis in the rumen and allows *F. necrophorum*, which is a part of the normal microflora, to multiply, gain entrance to the portal vein through ulcerated/eroded mucosa and infect the liver.

ImmTech's FUSOGARD™ *Fusobacterium necrophorum* bacterin has received USDA approval for prevention of footrot, which is caused by the same bacteria (*F. necrophorum*) that causes liver abscesses.

Materials And Methods – Footrot Trials

Twenty (20) commingled calves were vaccinated subcutaneously (SQ) with FUSOGARD™ (*F. necrophorum*) bacterin. Ten (10) unvaccinated, commingled calves served as control animals. Calves were vaccinated twice, at day 0 and day 21, with 2 mL of *F. necrophorum* bacterin. All calves were challenged at day 35 of the trial (14 days post-second vaccination) with a highly virulent strain ($2X10^8$ CFU/mL) of *Fusobacterium necrophorum.* All calves were clinically evaluated for lameness, joint/soft tissue swelling and abscessation during the 19 day post-challenge observation period.

All unvaccinated control calves showed severe lameness (Figure 1) at 24 hours post-challenge. Lameness did not resolve during the trial period. Three (3) of the 20 vaccinated calves showed mild lameness at 24 hours post-challenge, but were normal by 16 days post-challenge. All unvaccinated control animals exhibited severe swelling (Figure 2) and abscessation (Figure 3). Only a few vaccinated calves displayed mild swelling that completely resolved before the end of the trial period. Vaccinated animals showed no temperature spikes post-challenge, whereas all control animals had mild fevers (≥ 104°F) 4-5 days post-challenge.

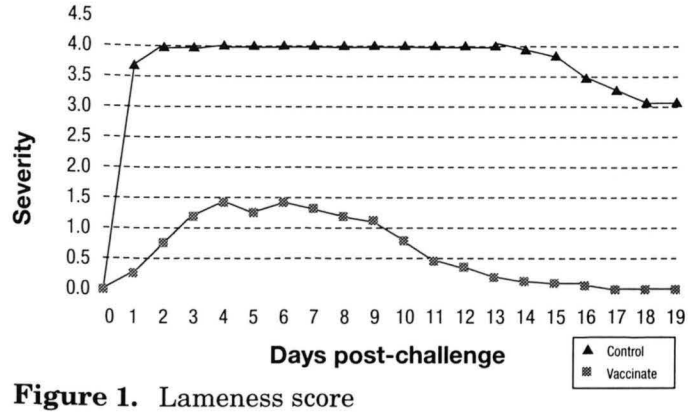

Figure 1. Lameness score

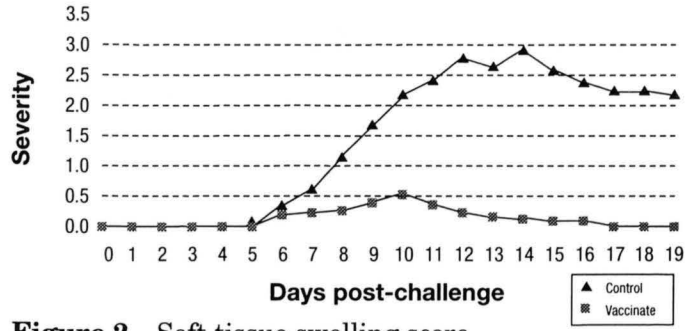

Figure 2. Soft tissue swelling score

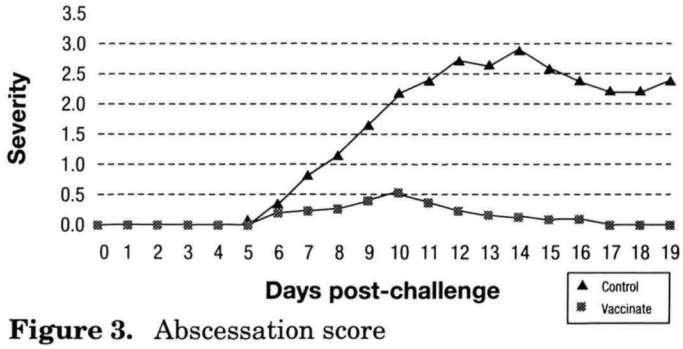

Figure 3. Abscessation score

Materials And Methods – Liver Abscess Trials

Animals

Trials were conducted on approximately 800-850 lb. commercially fed cattle in four feedlots. They were randomly selected to obtain a uniform weight and were mixed breed. The animals were fed a high-concentrate diet including Tylan® as soon as they arrived at the feedlot. The controls and vaccinates were identified by different-colored ear tags. The animals were fed for approximately 150 days before they were sent to the packing plants.

Vaccine

Fusobacterium necrophorum bacterin production serials were used for all trials. The animals were vacci-

nated when they arrived at the feedlot and re-vaccinated at day 60 with a 2 mL dose, subcutaneously.

Test Protocols

The liver from each animal was carefully checked by the local meat inspector, who was blinded to the treatment group. Each abscessed liver was then scored according to the Elanco scoring system. In each trial, the vaccinated and control animals were processed on the same day and scored by the same inspector.

Results And Discussion – Liver Abscess Trials

A total of 768 head of commercially fed cattle, representing four different feedlots, were used for this study. Of these, 201 or 26% were reported positive for liver abscesses. In all four trials, vaccinated animals showed significantly lower numbers of abscessed livers compared to the controls (Figures 4-7). Most significant was the A+ category, which indicated that *Fusobacterium necrophorum* bacterin was able to significantly reduce the severity of liver abscesses.

Fusobacterium necrophorum bacteria were easily isolated from the abscessed livers of control animals. In some of the vaccinated animals, abscessed livers were healed, forming scar tissue, and in many cases, bacteria could not be isolated. It appears that even though some of the vaccinated animals developed liver abscesses, they were smaller and rapidly healed. The results of the four trials reported here demonstrate the efficacy of FUSOGARD™ *Fusobacterium necrophorum* bacterin in reducing the size and number, thus, the severity of liver abscesses.

FUSOGARD™ Safety Trials

The safety trial was composed of 597 mixed-breed cattle from three separate locations. All received a single 2 mL SQ injection, followed three weeks later with another single 2 mL SQ injection, according to label directions. At 3-5 days post-vaccination, each calf was palpated at the injection site for signs of swelling, pain or evidence of inflammation and/or abscessation (see Table 1).

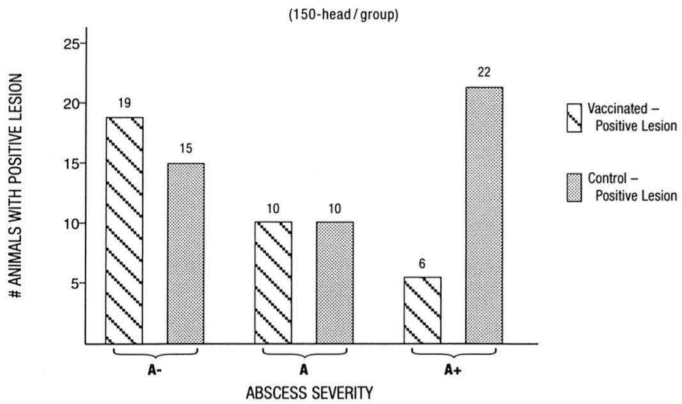

Figure 4. Reduction of liver abscesses in cattle following vaccination (Trial 1)

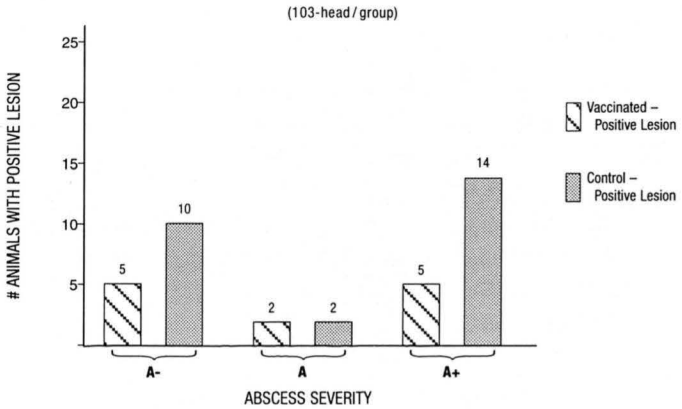

Figure 5. Reduction of liver abscesses in cattle following vaccination (Trial 2)

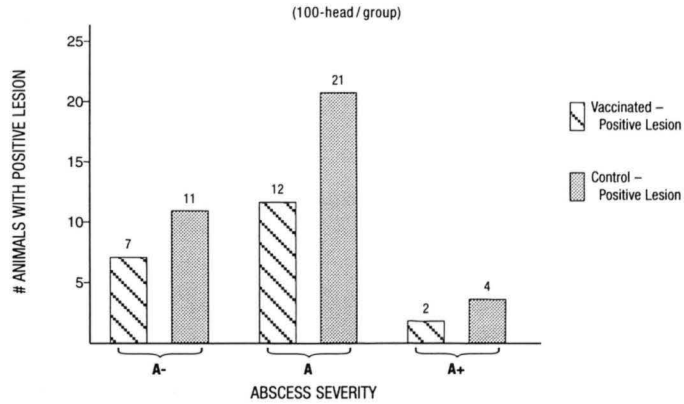

Figure 6. Reduction of liver abscesses in cattle following vaccination (Trial 3)

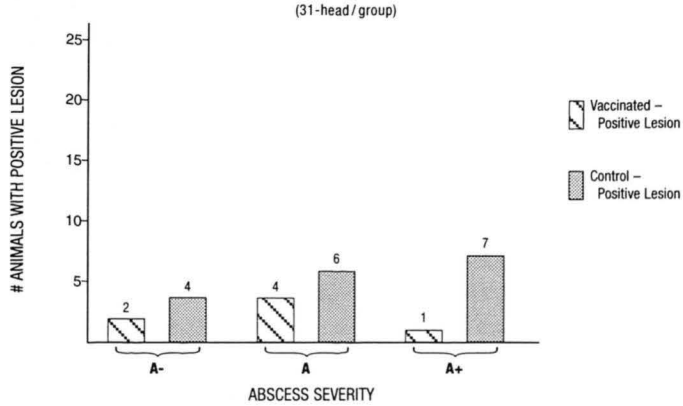

Figure 7. Reduction of liver abscesses in cattle following vaccination (Trial 4)

Table 1. Summary of Field Safety Trials

Trial No.	No. Animals	First dose No./nodule	%	Second dose No./nodule	%
1	200	15	7.5	7	3.5
2	189	0	0	7	3.7
3	208	7	3.3	12	5.8

Trial #1 Results—In a group of 200 (500-600 lbs.) mixed-breed calves, 7.5% (15/200) developed slight swelling at the injection site after first vaccination. Swelling was resolved within 10 days post-vaccination. Approximately 3.5% (7/200) developed slight swelling after the second dose. Swelling was completely resolved by 8 days post-vaccination. No other local or systemic reactions were observed during the study.

Trial #2 Results—In a group of 65-head of 10-month-old mixed-breed heifers (± 825 lbs.) and 124-head of similar age mixed-breed steers (± 850 lbs.), no local or systemic reactions were reported after the first 2 mL vaccination. Approximately 3.7% (7/189) developed pea-size injection-site lesions after the second vaccination which were resolved by 7 days post-vaccination. No abscessed lesions or systemic reactions were observed for the duration of the trial.

Trial #3 Results—In a group of 208-head of mixed-breed cattle, 3.3% (7/208) developed an injection-site lesion that was totally resolved by 9 days post-vaccination. Approximately 5.8% (12/208) developed injection site lesions after the second 2 mL vaccination. All of the nodules were firm, small and resolved by 8 days post-vaccination. There was no apparent pain, restlessness or systemic lesions observed throughout the trial.

Conclusions

- FUSOGARD™ *Fusobacterium necrophorum* bacterin is able to provide protection against a virulent strain of *F. necrophorum* by significantly reducing lameness, soft tissue swelling and abscessation typical of footrot.
- FUSOGARD™ *F. necrophorum* bacterin can significantly reduce the severity of liver abscesses while providing an alternative and/or conjunctive management tool to help reduce and/or eliminate the meat industry's concern of antibiotic resistance and meat residue concerns linked to feed-grade antibiotics.
- FUSOGARD™ bacterin is safe when administered according to label directions.

References

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