

Project Summary

Comparison of the BioBullet Versus Traditional Injection Techniques on Tissue Damage and Tenderness in Beef Subprimals

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Background

In 1997, research demonstrated that subprimals that contained lesions had higher shear force values and greater tenderness variation than non-injected control subprimals. As a result of this and similar research, greater influence was placed on moving injections to the neck region for all routes of administration of pharmaceutical products. More recently, SolidTech Animal Health Inc. or Newcastle, OK has devised a method for injectable administration that uses an air-powered delivery system and biodegradable projectiles containing products such as freeze-dried ceftiofur sodium. Previous research at Oklahoma State University indicates that the BioBullet administration method of Naxcel, when used at least 30 days prior to harvest, led to no detectable increase in tissue damage or tenderness. However, no comparisons have been made between the bio-bullet and traditional administration techniques. The objective of this project was to evaluate the impact of administration technique on lesion occurrence, tenderness and collagen content in muscles of the round and muscles of the chuck.

Methodology

A total of 191 yearling steers were selected to ensure they had no previous injection in the neck or round muscles on the animal's right side, no prior treatments for bovine respiratory disease, British x Continental phenotype and were within a specific range for body weight. Based on initial body weight, steers were blocked into 2 groups of 96 head each and randomly allocated within block into 32 pens of 6 head each (16 pens per block). Each pen was randomly assigned to one of the following injection treatments: 1) standard BioBullet containing 100 mg of Naxcel; a traditional needle and syringe dose of Naxcel; a standard BioBullet containing Titanium5; a traditional needle and syringe dose of Titanium 5; a needle-less injection of Vista 5; a traditional needle and syringe dose of Vira Shield 5; a standard BioBullet containing no pharmaceutical product; and a traditional needle and syringe dose of sterile water. All steers were also implanted with estradiol and trenbalone acetate. For the majority of the trial, steers were fed a 95% concentrate finishing diet.

In treatments including Naxcel, Titanium 5, and sterile water BioBullet and traditional needle comparisons, cattle were administered the dosage intramuscularly in either the neck or round region. The Vira Shield 5 treatment group was injected in the neck region subcutaneously. A trained Solid Tech Animal Health representative administered all BioBullet dosages at a distance of 6.1 meters, while trained OSU staff administered all other injections. BioBullet and traditional injections were placed in the same location either in the neck or in the round.

Carcass data was collected and outside round flats and 2-piece boneless chucks from the right side were collected. Subprimals were vacuum packaged and aged 14 days at 3°C. After aging, each subprimal was fabricated into 1.27 cm steaks and steaks were observed/palpated for the presence of injection site lesions. When a lesion was identified, the lesion was verbally described using a 5-point classification system which categorizes lesions as cystic, scar with nodules, mineralized scar, clear scar or woody callus. Histopathological examination of muscle samples was also performed to verify that tissue damage was the result of an injection. Steaks were also analyzed for tenderness, moisture, lipid content and collagenous connective tissue content.

Findings

There was little difference in yield grade and quality grade between treatment groups. However, it was observed that the needle Titanium 5 group harvested with the lowest quality grade (Slight 65) and yield grade (2.54) while the treatment group with the highest quality grade was needle Vira Shield 5 and the treatment with the highest yield grade was BioBullet Naxcel.

Lesion Presence & Histology

Out of 69 round and 60 chucks evaluated, a visual lesion was identified in 71.83% of all control (H₂O) rounds, which was similar to rounds injected with Naxcel, which had a 70.83% visual lesion presence. Rounds injected with Titanium 5 had a visual lesion present in 77.83%, which was the highest percentage of all rounds or chucks. The highest lesion percentage in among chucks was 56.94% in chucks injected with Naxcel.

Although lesion occurrence was not significantly different between the two routes of administration, 83.33% of rounds injected with a BioBullet had a visible lesion as compared to 63.66% of round injected using a needle, 56.25% of chucks injected with a BioBullet and 57.08% of chucks injected with a needle. The types of lesions found in the chucks and rounds included clear scars and woody calluses, as well as metallic and nodular lesions. Lesions found in the chuck roll and clod were commonly found in seam fat between muscles, whereas the lesions found in the round were generally found in lean muscle tissue. These results indicated variable lesion type and occurrence in beef subprimals from injection route and product type. In all lesioned steaks evaluated there were mature fibrous tissue and collagen fibers within adipose tissue.

Tenderness

An interaction between route of administration and product injected was observed in beef chuck lesion cores from chucks injected with a BioBullet H₂O or a needle Naxcel where WBSF values were 6.27 kg and 5.08 kg, respectively. Based on these results and previous evidence, no detrimental effects on beef tenderness would likely be realized with BioBullet treatment for 21 days or more before slaughter. The steak of the same interactions of BioBullet Titanium 5, BioBullet H₂O, needle Naxcel were 4.78 kg, 4.73 kg and 4.61 kg, respectively. Warner-Bratzler shear force values for samples 7.62 cm away from the lesion center were significantly different in shear force values, with the toughest samples resulting from the needle H₂O interaction group.

Collagen Content & Lipid Content

When a wound or injury occurs, the healing process involves the deposition of connective tissue and collagen in and around that wound. There were no significant differences found in the total collagenous connective tissue in samples extracted from the chuck and round.

When damage occurs to living muscle, fat deposition increases. The comparison between the lesion site and control (no lesion site) samples for lipid concentrations showed no significant difference for route or product in the round. However, for lipid concentrations in the chuck, values calculated from steaks from the Titanium 5 treatment group were shown to be significantly different from steaks from the Naxcel treatment group. H₂O steaks were not different from steaks from Naxcel steaks or the Titanium 5 vaccine steaks.

Implications

Although injection-site lesions are decreasing in prevalence, new technologies have given a new twist to the traditional needle syringe. Utilizing these new routes of administration may ease the stress of handling livestock several times for repeated vaccination, but concern must be raised in that the emerging technology causes similar amounts of tissue damage in valuable muscle. From a production standpoint, the results indicate that it is still best to administer vaccines, regardless of the route of administration, to cattle anterior to the scapula to decrease the chance of lean tissue being damaged, resulting in trim loss and decreased tenderness.

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