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Investigating the Etiology of Increased Incidence of Sour Knuckles in Commercial Beef Processing Facilities

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Objectives

Cattle weights have increased during the last couple of decades and have not always been accompanied by improvements in facility capabilities and management. Alongside quality issues of color, tenderness, and water holding capacity, issues such as sour muscles and bone taints are now appearing with great frequency in the meat industry. Development of off-flavor/sourness in deep muscles such as knuckles (*vastus femoris, vastus lateralis,* and *vastus medialis,* and *rectus femoris*) has been a long-standing issue in the beef industry, however, has not been well characterized. Therefore, the objective of this study was to investigate the cause, and characterize sour odor associated with beef knuckles using microbial, odor panel, and gas chromatography-mass spectrometric (GC–MS) analyses.

Materials and Methods

Knuckles (n = 10) identified as having no sour odor (control), slight odor, or severe odor were collected from the fabrication line of a commercial beef processing plant. Sponge samples of synovial fluid and femur surface of the round were also obtained at the time of collection, for determination of anaerobic sporeformer counts. The collected knuckles were transported on ice to the laboratory where they were aseptically separated into two halves, with one half destined for microbial, odor, and GC–MS analyses on the day of collection (Day 0) and the other half for the same analyses after 35 d of vacuum packaged storage at 2°C (Day 35). For microbial analysis, 15 g of tissue was excised from the muscle surface and was analyzed for aerobic plate counts (Petrifilm Aerobic Count plates) and lactic acid bacteria counts (Lactobacilli MRS agar). Samples (5 g) for GC–MS were held at –80°C until analysis. The remainder of the sample was diced and used for trained odor panels. Data were analyzed using the ANOVA function in R (v. 3.5.1.), with a significance level of $\alpha = 0.05$. Upon finding significant differences ($P < 0.05$) the means function was used to determine differences between groups.

Results

Irrespective of sourness classification of the knuckles, similar ($P > 0.05$) anaerobic sporeformer counts were obtained for the synovial fluid and femur surface. Additionally, muscle tissue samples from control, slightly sour and severely sour knuckles had similar ($P > 0.05$) aerobic plate counts and lactic acid bacteria counts. Odor panelists identified differences ($P < 0.05$) for all attributes between control and sour knuckles (slight and severe) on Day 0. Similarly, on Day 35, differences ($P < 0.05$) were observed between control, slightly sour, and severely sour knuckles for all attributes, with severe receiving the highest score for all categories. GC–MS results showed no differences ($P > 0.05$) between control and sour knuckles for propionic, butyric, isobutyric, and acetonic acid.

Conclusion

Microbiological analysis found no differences in culturable organisms between control, slight, and severely sour knuckles on Day 0 or Day 35. However, odor panelists were able to identify differences between control and sour knuckles even after 35 d in vacuum packaging. GC–MS analysis did not indicate a statistical difference in the abundance of volatiles between the treatments, probably due to high variations within treatment groups.