

Effects of Bacteriocins on Shelf Life of Ground Beef:

Meat spoilage is one of the largest problems in the meat industry, costing producers, processors, and retail stores millions of dollars in product losses annually (Nyphas et al., 2008). Nonpathogenic psychrotrophic microflora on the surface of retail cuts of beef have the ability to grow at refrigeration temperatures and spoil the product by producing gas, off flavors, and/or off colors. These organisms are often indigenous to meat animals and contaminate the carcass during slaughter (Paramithiotis et al., 2009). The average shelf life of ground beef is approximately 36-48 hours (Martin and Brooks, 2012); modified atmosphere packaging may extend it to 3-4 days. Many producers are in search of an effective way to combat the growth of psychrotrophic bacteria in order to elongate the shelf life of ground beef. Many consumers are interested in a product that can be purchased and saved until cooking at a convenient time and are offended by a product that is purchased and spoils within 1 day. Supermarkets are then faced with returns and credits to consumers who return the quick-spoiled products. Finding a way to inhibit these spoilage bacteria would benefit both the producer and the consumer. Ground beef is especially prone to spoilage because bacteria on the surface is now on the inside and grinding increases the surface area.

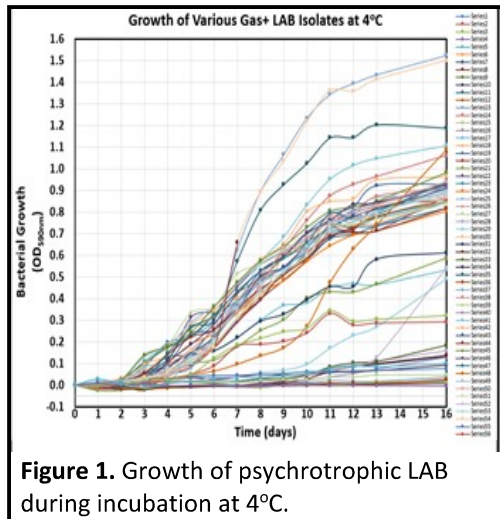


Figure 1. Growth of psychrotrophic LAB during incubation at 4°C.

One way to combat this problem would be to find a way to inhibit growth of these problematic psychrotrophic bacteria via safe topical treatments on beef trim before grinding into ground beef. I propose to do this using bacteriocins as a processing aid during a pre-grind treatment. Bacteriocins are proteins produced by bacteria that are inhibitory to other bacteria. Lactic acid bacteria (LAB) are a class of 'safe' bacteria that produce bacteriocins (Bac+). LAB are generally regarded as safe (GRAS) by the FDA and USDA (Cleveland et al., 2001). The bacteriocins produced by LAB are currently being tested against foodborne pathogens for the purpose of food safety. However they can also be used for inhibition of non-pathogenic spoilage organisms that would improve quality and increase shelf life. My project will be to find bacteriocins that inhibit some of the psychrotrophs in the figure above. Even though meat is refrigerated to allow storage of the product without spoilage, refrigeration temperatures do prevent all of the bacteria that contaminate meat from growing. Unlike pathogens, which must be completely eliminated to prevent disease, we would only need to reduce/slow the growth of the psychrotrophs, thereby increasing the shelf life of ground beef by 1-2 days, and would save the industry millions of dollars.

The project would take place over a full year, beginning with the isolation of spoilage-causing bacteria commonly found in ground beef and confirming their growth at refrigeration temperatures by spectrophotometric growth curve analysis of inoculated cultures held at 4°C. I will then identify select isolates by PCR and sequence analysis of the 16S rRNA (OSU DNA Core Facility). Once that is done, LAB that produce bacteriocins would be examined for inhibition of the spoilage LAB using spent culture supernatants to spot onto bacterial lawns of the spoilage organism. The spoilage bacteria will be plated as a 'lawn' on agar plates and 'spotted' with cell free culture supernatant of various bacteriocin-producing strains. Those that inhibit the spoilage organism(s) will show a 'zone of inhibition'. Select Bac+ bacteria that strongly inhibit our spoilage organisms will be used to spray beef trim before grinding in comparison to samples sprayed with water (control) or lactic acid (common industry intervention). Bacteriocins are known to be heat stable, so preparations can be pasteurized to maintain stability during storage. After spray treatment, the beef trim will be ground, encased in plastic casing by grinder extrusion, and stored at 4°C. Ground beef samples will be plated daily (for up to 14 days) for total LAB, APC, and observed for quality attributes (color, odor). This procedure will be followed in triplicate to provide statistical significance of the data. The data will be presented during OSU Research Week.

Literature Cited:

- Paramithiotis S., et al. 2009 *Safety of Meat and Processed Meats*, 3, 51-75
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Martin J, and C. Brooks. 2012 *Ground Beef Shelf Life*. 12th ed. Vol. 226. 13-14.
Cleveland J., et al, 2001 *Bacteriocins: Safe, Natural Antimicrobials for Food Preservation*, 1st ed. Vol. 71. 1-20.