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Beef Science Cluster

Providing Consumers With More Tender Roasts

Project Title:

Improvement of High Connective Tissue Beef Cuts with Collagenolytic Enzymes

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Background

Connective tissue (gristle) is a part of muscle and is a significant cause of tough beef. The end cuts of beef in the carcass contain more connective tissue than the middle cuts. Collagen protein is the main type of connective tissue. Grinding improves tenderness by physically breaking up the collagen, but this doesn't help tough steaks and roasts. Pumping beef with salt or phosphate can tenderize the steaks and roasts, but it can negatively affect flavor. Enzymes that degrade collagen can tenderize beef, but commercially available collagenolytic enzymes (collagenases), often degrade more than just collagen and make the product 'mushy' or 'granular'.

Objective

The overall objective is to improve the tenderness of beef cuts from the ends of the carcass by identifying collagenases that will degrade collagen without negatively affecting palatability.

What they did

Four plant enzymes, actinidin (from kiwi fruit), zingibain (from ginger), papain (from papaya) and kachri (from wild cucumber) were identified through literature review as having activity against collagen. These enzymes were applied to bovine collagen purified from eight outside round muscles for 48 hours at refrigerated temperatures (4 to 8ºC). The effect of enzymes on the collagen was estimated by then heating the collagen at 77ºC for 1 hour and then measuring how much collagen had been released into the cooking solution. Dilute crude enzyme extracts and commercial preparations were also applied to outside round using a commercial injector to simulate use under commercial conditions. Beef roasts were injected with enzymes, water (positive control)

or not injected (negative control) and then all roasts were tumbled by treatment group. Roasts were stored in vacuum packaging for 24 hours at 4ºC and the cut into steaks, vacuum packaged and then frozen until meat quality and sensory analysis. Upon thawing, steaks were assessed for pH, colour, drip loss, cooking loss, cooking time, toughness and sensory characteristics.

What they learned

When applied at concentrated levels, all enzymes released collagen into the cooking solution, indicating that prolonged (48 hours) exposure of the collagen to all enzymes degraded collagen. Injection of the plant enzymes required dilution of the kachri, actinidin and ginger solutions because these solutions were too thick for the needle injectors to function without plugging. Papain increased the tenderness of the outside round steaks compared to that of water and non-injected control, while all other enzymes had no effect. All injected steaks had more drip and cooking losses and were more yellow (except papain) than non-injected steaks. Sensory panel results indicated that greater than 80% of the panelists rated the beef injected with papain as not tough enough (too soft) and as having the lowest mean acceptance score. Between 40 and 50% of the panelists thought that beef injected with water (positive control), ginger, actinidin and kachri was too tough, while approximately 55% of panelists agreed that beef not injected (negative control) was too tough. Beef injected with actinidin (kiwi) had a fruity flavor that was detectable by 8% of the panelists. Similarly, a ginger flavor was detectable by 18% of the panelists. Beef that was treated with kachri also had a distinct flavor detectable by 9% of the panelists, while papain was associated with blandness, liver flavor and after tastes. Consumer acceptability indicated that papain-treated beef was disliked extremely, whereas beef that was treated with actinidin, ginger and kachri was liked moderately. Kachri had the highest proportion of panelists in the “liked very much” category, suggesting that this enzyme may be the best enzyme to investigate further to optimize the amount of enzyme used to enhance beef tenderness.

What it means

Based on the results, all enzymes tested increased the heat solubility of perimysium, and are therefore potentially useful for the tenderization of meat. Although papain reduced the toughness of the beef substantially, the beef became too soft and was found unacceptable by a consumer panel. Sensory analysis indicated that the flavours imparted by kachri and ginger were acceptable and if a method of injecting a more concentrated solution of these crude enzyme mixtures could be devised, then tenderness may be improved along with the flavour.

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