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Meat Safety News Digests

A collection of recent news relevant to the safety of red meat prepared by the Food Safety Program of Meat & Livestock Australia, for SAFEMEAT Stakeholders

INTERVENTIONS

Effectiveness of in-plant interventions in reducing pathogens on veal calf hides

The focus of this American study was to evaluate the effectiveness of hide interventions currently used at veal processing plants. Three different interventions were considered: (A) a water rinse followed by a manual curry comb of the hide; (B) application of 200 ppm of chlorine followed by a hot water rinse; and (C) a 5-min treatment with chlorine foam followed by a rinse with 180 to 200 ppm of acidified sodium chlorite. The effectiveness of these interventions was assessed by determining and comparing the levels of total aerobic bacteria, *Enterobacteriaceae*, coliforms, and *E. coli*, as well as the prevalence of *Salmonella*, O157 EHEC, and non-O157 EHEC on hides pre- and post-intervention. The results revealed that interventions A, B, and C reduced indicator organisms by 0.8 to 3.5 log CFU, 2.1 to 2.7 log CFU, and 1.0 to 1.5 log CFU, respectively. Among all pathogens tested, only non-O157 EHEC was detected at all processing plants, and therefore, comparison of data was possible. The prevalence of non-O157 EHEC appeared to be reduced by 29 and 21% when interventions A and B were used, respectively. By contrast, intervention C did not reduce non-O157 EHEC. The results of this study concluded that intervention B was the most effective in reducing indicator organisms and EHEC.
http://www.ncbi.nlm.nih.gov/pubmed/24780328

Lethality of moist heat and sanitizer combinations on *Listeria* species

This American study investigated the effectiveness of different sanitizing treatments on *Listeria* spp. adhered to the components of deli meat slicer. A cocktail of seven *Listeria* isolates (five strains of *Listeria monocytogenes* and one each of *Listeria innocua* and *Listeria ivanovii*) was used to inoculate stainless steel and aluminium coupons (pieces of 1.8 x 2.4 cm and 2 x2.5 cm, respectively). These inoculated coupons along with controls were subjected to (a) moist heat (for 7 h at 66°C) only, (b) silver dihydrogen citrate (SDC) only and (c) moist heat plus SDC both inside and outside of meat slicer. Efficacy of these treatments against *Listeria* was evaluated by enumerating surviving *Listeria* cells post treatments. Results showed that all treatments produced significant log reductions as compared to positive and untreated negative controls. Silver dihydrogen citrate alone resulted in >5 log CFU/cm^2 reduction on both types of metal coupons, which was higher than the moist heat only treated external coupons (4.49 and 4.87 logs CFU/cm^2 for stainless steel and

aluminium respectively) but lower than internal coupons (> 6 logs).The highest log reductions (non-detectable levels) of *Listeria* spp. were achieved when SDC was used in combination with moist heat (for both types of metal surfaces placed either inside or outside the meat slicer). Thus sanitizer and moist heat combination can effectively reduce the *Listeria* cells attached to food contact surfaces under food processing environments.
http://www.sciencedirect.com/science/article/pii/S0956713514001558

Use of high pressure in combination with dietary supplement to enhance the quality and safety of beef

In this Korean study, researchers evaluated the potential for using high pressure (HP) to infuse a dietary supplement (i.e., conjugated linoleic acid, CLA) to beef meat, in order to enhance its quality and storage stability. Beef lions with and without 1% of CLA were vacuum-packed and treated with HP at 0.1, 300, 450, and 600 MPa for 5 min. The results revealed that CLA level, cooking loss (i.e., total weight loss due to cooking), and pH increased when higher pressure was used (from 2.87 mg/g, 41.31%, and 5.92 to 4.48 mg/g, 45.41%, and 6.07, respectively). Total aerobic bacteria were not detected only in the meat samples treated with HP at 450 and 600 MPa. However, it was found that the samples treated with HP at 300 MPa showed the highest overall acceptance. These findings indicated that application of HP (300 MPa) in combination with CLA (1%) could be used to improve the nutritional and microbiological quality of beef loin with acceptable sensory quality.
http://www.sciencedirect.com/science/article/pii/S1466856414000964

PREDICTIVE MODEL

Validation of predictive models for *Salmonella* in raw ground beef during loss of refrigeration

Temperature is one of the key factors in controlling the growth of microorganisms in food. In the current Model Food Code guidelines developed by the U. S. Food and Drug Administration (FDA), it is stated that food can be kept out of temperature control for no more than 4 h without qualifiers, or up to 6 h, if the food product starts at 5°C and does not exceed 21°C at 6 h. To challenge this, a group of American researchers used and validate existing models (ComBase) to predict *Salmonella* growth under changing temperature conditions modeling scenarios using raw ground beef.

Meat samples were inoculated with a cocktail of *Salmonella* serovars previously isolated from different meat products (e.g., *S.* Copenhagen, *S.* Montevideo, *S.* Typhimurium, *S.* Saintpaul, and *S.* Heidelberg). Inoculated samples were then held in a programmable water bath at 4.4 °C and subjected to linear temperature changes to different final temperatures (15.6, 26.7, or 37.8°C) over various lengths of time (4, 6, and 8 h) and then returned to 4.4°C. Growth of *Salmonella* was monitored periodically throughout experiments and compared with those data of the predictive models. The results showed that there was generally good agreement between the models and experiments when the final temperatures were below 26.7°C. However, when the final temperature was at 37.8°C, the predictive models provided fail-safe. The results of this study showed that the U.S. FDA Model Food Code guidelines for holding food out of temperature control

are conservative and highlighted that the ComBase models could be used to predict *Salmonella* growth under dynamic temperature conditions as might be observed due to power loss from natural disasters or during transport out of temperature control. http://www.ingentaconnect.com/content/iafp/jfp/2014/00000077/00000007/art00008

Predictive model for EHEC during processing and storage of fermented raw meat sausages

In this study, researchers developed a model to predict the levels of EHEC during processing and storage of fermented raw meat sausages. This model was based on kinetics data collected from publicly available resources and new data where required, to quantify the dependence of EHEC growth and inactivation on the temperature, pH, water activity, and concentration of lactic acid. The model showed that only slight differences in the reduction of EHEC were observed at two different fermentation temperatures (24 and 43°C), with greater inactivation at the highest temperature. The greatest reduction was also observed during storage at high temperatures. It was found that EHEC decreased greater than 6 log units after 66 days of storage at 25°C, whereas only 1-log reduction was detected at 12°C after the same storage time.

The model is included as part of the existing tool, known as '*E. coli* SafeFerment' (EcSF), and is freely available from http://www.ifr.ac.uk/safety/EcoliSafeFerment. This tool integrates growth, probability of growth, and thermal and non-thermal inactivation models to predict EHEC levels throughout the production and storage of fermented raw meat sausages under constant or fluctuating environmental conditions. http://aem.asm.org/content/early/2014/02/17/AEM.03791-13.short?rss=1

SHELF-LIFE

Storage life of chilled vacuum-packaged primals from decontaminated beef carcasses

This North American study established the effect of different carcass-decontaminating treatments on shelf-life of beef primal cuts. The decontamination treatments involved washing hide-on carcasses with 1.5% NaOH at 55 °C, followed by rinsing with chlorinated water; spraying skinned carcasses with 5% lactic acid before evisceration; spraying dressed carcass sides with 5% lactic acid; and pasteurizing sides with steam before they enter the carcass chiller. Correspondingly, cuts and conveyor belts used for the cuts were sprayed with 200 ppm peroxyacetic acid. For the study both boneless and bone-in vacuum packed loins from decontaminated beef carcasses were stored at 2±0.5 °C and −1.5±0.5 °C for 160 days and studied for microbiological and organoleptic characteristics.

The results showed that total viable counts on bone-in cuts reached maximum at around 30 (7.5 log cfu/cm^2) and 70 days (7.0 log cfu/cm^2) of storage at 2 °C and −1.5 °C respectively. Whereas, on boneless cuts the maximum counts were observed at 50 (7.8 log cfu/cm^2) and 90 days (7.0 log cfu/cm^2) at 2 °C and −1.5 °C storage temperatures respectively. Further, odours of boneless cuts were acceptable for up to 160 days (both at 2 and −1.5 °C) and flavours for ≤ 70 (at 2°C) and ≤ 150

days (at −1.5 °C). The storage life of bone-in cuts was found shorter than that of boneless. Study showed that storage life of up to 120 days at ≤ 2°C and −1.5 °C is attainable for North American beef primals, provided appropriate carcase decontamination practices are implemented in the abattoirs. http://www.ncbi.nlm.nih.gov/pubmed/24647970

Effect of vacuum-packed beef pH on growth of psychrotolerant species of clostridia and blown pack spoilage

A group of Canadian and Egyptian researchers investigated the effect of meat pH on the growth of 11 species of psychrotolerant *Clostridia* (*Clostridium algoriphilum*, *Clostridium algidixylanolyticum*, *Clostridium bowmanii*, *Clostridium estertheticum*, *Clostridium frigoris*, *Clostridium frigidicarnis*, *Clostridium gasigenes*, *Clostridium lacusfryxellense*, *Clostridium psychrophilum*, *Clostridium tagluense* and *Clostridium vincentii*) and their ability to cause blown pack spoilage of vacuum-packed beef. For this study beef steaks of three pH categories, 5.5 (normal), 5.7 – 5.9 (intermediate) and ≥6 (high) were inoculated with log phase cultures of specific *Clostridium* and vacuum-packed for storage at 2 °C for 56 days. Volume of each pack was measured immediately after packaging and thereafter at regular intervals during storage. All clostridia grew on high pH beef but none caused blown pack spoilage. However, swelling was observed in meat packs of intermediate and normal pH inoculated with *C. estertheticum* after 14 days with mean rates of 6.80 and 7.70 ml/day respectively. *C. frigoris* caused early onset of blown pack spoilage of intermediate pH beef although inconsistently. The numbers of most of *Clostridium* spp. were higher (2.0 – 3.6 log units) on high pH meat than intermediate and low except for *C. frigidicarnis* and *C. lacusfryxellense* (highest on intermediate pH meat), *C. estertheticum* (higher on low pH) and *C. tagluense* (same on all pH meats). Further, all *Clostridium* spp. resulted in significant reduction in glucose level of high pH meat rinse fluids as compared to intermediate and normal pH meats, where reduction in glucose concentrations were observed only when meat was inoculated with *C. estertheticum*. The findings of this study clearly indicate that only *C. estertheticum* and *C. frigoris* are the causative bacteria for blown pack spoilage of chilled vacuum-packed beef. http://www.sciencedirect.com/science/article/pii/S0740002013002098

Bacteria and their volatiles associated with meat spoilage

Meat spoilage is a complex process, a combination of interacting biological and chemical activities. Besides intrinsic lipid oxidation and other enzymatic reactions, spoilage results from microbial activity of wide variety of microorganisms belonging to Acinetobacter, Pseudomonas, Brochothrix, Flavobacterium, Psychrobacter, Moraxella, Staphylococcus, Micrococcus, *Clostridium*, lactic acid bacteria and different genera of family *Enterobacteriaceae*. However, the type and extent to which different microbes colonize the fresh meat depend largely on temperature of storage and packaging conditions. The microbial development and consumption of meat nutrients by bacteria results in the release of metabolites such as volatile organic compounds. The volatile organic

compounds such as alcohols, aldehydes, ketones, fatty acids, esters and sulphur compounds that are generated during meat storage can have an olfactory impact thereby resulting in rejection of the product when their concentration increase significantly. In this review, describes the volatile organic compounds found in fresh meat during storage under commonly prevalent storage conditions along with the possible bacterial populations responsible of their production. Further, the sensory impact of these volatile compounds and their dynamics during storage are discussed to highlight their possible contribution to ultimate meat quality. The future prospect to use dominant volatile organic compounds as possible markers in intelligent packaging for an early detection of meat spoilage is envisaged.
http://www.sciencedirect.com/science/article/pii/S0740002014000276

E.COLI

Thermal inactivation of EHEC in mechanically tenderized veal

Researchers from USA investigated thermal inactivation of O157 EHEC and non-O175 EHEC in mechanically tenderized veal. In this study, veal cutlets were surface inoculated with approximately 7.0 log CFU/g of a multi-strain cocktail of O157 EHEC or a cocktail made of single strains of non-O157 EHEC prior to mechanical tenderization. Inoculated and tenderized cutlets were then subjected to different cooking practices, i.e., in 15 or 30 ml of canola oil for 0.0, 0.75, 1.0, 1.25, 1.5, 1.75, or 2.25 min per side on an electric skillet set at 191.5°C. The overall results showed that the longer the cooking times, the higher was the internal temperature of the meat, along with a greater reduction of both O157 EHEC and non-O175 EHEC regardless of the volume of oil used. The average final internal temperature of the meat appeared to range from 56.8 to 93.1°C. However, similar reductions of O157 EHEC and non-O15y EHEC were observed, ranging from 2.0 to 6.7 log CFU/g. This indicated that the responses of O157 EHEC and non-O157 EHEC to thermal inactivation were similar. Furthermore, the study concluded that to achieve approximately a 5.0-log reduction of O157 EHEC and non-O157 EHEC, and to achieve the recommended internal temperature of 71.1°C, mechanically tenderized veal cutlets should be cooked for at least 1.5 min per side on a pre-heated electric skillet set at 191.5°C and containing 15 ml of cooking oil.
http://www.ingentaconnect.com/content/iafp/jfp/2014/00000077/00000007/art00022

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