Meat technology-What's new

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Eating quality of frozen Australian lamb

Although the amount of chilled lamb for export is increasing, a considerable proportion of Australian lamb is still exported in the frozen form. Lamb carcases can be processed into bone-in or boneless cuts: on the same day as slaughter; after overnight chilling; or after weekend chilling. The cartoned product can then be frozen over two days in a blast freezer, or more rapidly in a plate freezer. The effect of these different processing conditions on tenderness and eating quality of lamb leg meat has recently been assessed.

Lambs processed in a Western Australian abattoir were boned a half, one and three days after slaughter. Legs packed in cartons were frozen for 40 hours in a blast freezer operating at –25°C, or for 12 hours using a plate freezer at –35°C. Tenderness as assessed by shear force measurement and by a consumer panel showed that meat frozen on the day of slaughter was significantly tougher than when frozen one and three days after slaughter. There were no effects of the treatments on drip loss, juiciness, flavour or overall liking. It was concluded that freezing lamb meat after warm boning 0.5 days after slaughter is likely to reduce tenderness and consumer satisfaction rating.

Influence of finishing system on fatty acid composition and display life of lamb

Pasture quality in southern Australia normally declines during late spring and summer and supplementary feeding is required to finish lambs to the desired weight. Feeding with grain and hay can affect the fat composition and retail display life of the lamb meat. To determine the influence of the diet, 30 cross-bred lambs were divided into two groups. One group was allocated to pasture and the other to a grain-based diet with cape-weed hay for 5 weeks. During the latter 2 weeks of the trial the quality of the pasture declined due to hot, dry weather. After slaughter samples were collected for fatty acid analysis and colour stability during simulated retail display.

Grain-finished lamb had higher muscle fat and higher omega-6 fatty acid content. When the colour of lamb chops on simulated retail display was measured instrumentally, the colour stability of the grass-finished meat was superior to that of the grain-finished product. It was speculated that this was due to reduced vitamin E in the grain diet, but an economic incentive would be required for producers to include vitamin E in the grain supplement.

Protein denaturation of deep *semimembranosus* muscle negatively affects meat tenderness

Beef cuts from the topside (*m. semimembranosus*) often have a two-toned appearance, with a paler red colour in the deeper muscle than in outer, superficial muscle. Due to the thickness of the muscle, the deeper tissue has a slower cooling rate and a more rapid pH decline than the outer tissue. These conditions can be accentuated when electrical stimulation is applied. The high temperature–low pH condition affects muscle protein functionality leading to reduced water-holding capacity and poor colour stability.

The protein denaturing conditions in the deep muscle affects post-mortem proteolysis, and a study was undertaken to determine the effect on meat tenderness. Steaks were cut from the *semimembranosus* (SM) one day after slaughter and packed in high oxygen (80% O_2/20% CO_2) MAP packs and displayed under fluorescent lighting. After designated display times, samples were removed and separated into: a deep portion from nearest the bone; and a superficial portion from near the outer surface of the carcase—for analysis.

There was greater protein denaturation of the meat from the deep SM than from the superficial SM, and the deep muscle was significantly tougher than the outer muscle. This tenderness variation was attributed to the limited degradation of the myofibrillar proteins and μ-calpain autolysis due to protein degradation resulting from high temperature–low pH conditions in the deep muscle (heat toughening).

Rapid determination of ammonia in meat exposed to ammonia leaks

Ammonia leaks occur occasionally in industrial refrigeration systems, and meat and meat products can be exposed to ammonia gas. The gas is readily absorbed by the meat with effects on the flavour, colour and pH. Currently the most reliable method of detecting whether meat has been affected by ammonia is sensory analysis. Total nitrogen determination is not a sensitive enough measure, and pH is not a reliable indicator due to the buffering capacity of the meat.

An ammonia ion selective electrode (ISE) has been used successfully to determine quality and deterioration of seafood and for determining ammonia content of water, juices, soil, plants and wastewater. A study was undertaken to assess whether the ammonia ISE could be used as a rapid method of measuring the ammonia content of red meat that had been contaminated with ammonia.

Beef steaks were contaminated with ammonia at levels up to 5,000 ppm for 0, 5, 10 and 20 minutes. Ground samples were then mixed with distilled water and an ionic strength adjuster added to release ammonia from the tissue. The mV reading from the instrument was converted to ppm ammonia concentration using a standard curve. The electrode had a response time of 1 minute or less and the results showed increases in ammonia content as ammonia concentration and exposure time increased. It was much more sensitive than measurement of ammonia content using the AOAC standard method.

Foreshank manipulation to improve beef chuck tenderness

Tenderstretching by hanging the carcase from the aitch bone or the sacrosciatic ligament has been used to improve the tenderness of loin and hindquarter muscles. A West Texas A&M University study has assessed the effect on tenderness of forequarter muscles of holding the foreshank in a range of positions until the completion of rigor.

Four different positions for the foreshank were studied: A—the natural position, cranially (forward) to the point of the shoulder; B—caudally (backward) at greater than 30° angle to the floor; C—cranially perpendicular to the floor, and D—parallel to the floor. The tenderness of seven different chuck muscles was studied by measurement of sarcomere length, Warner-Bratzler shear force and in-home sensory evaluation.

Repositioning the foreshank perpendicular to the floor increased the sarcomere length of all muscles and improved the tenderness as measured by the shear force and sensory evaluation. Sensory evaluation showed that the *pectoralis profundus*, *supraspinatus*, and *serratis ventralis* muscles were significantly improved by perpendicular positioning of the foreshank.

Rapid detection of *E. coli* O157:H7

Using traditional techniques, it can take up to a week to confirm the presence of *E. coli* O157:H7 in samples of ground beef. These methods are complicated, labour intensive and expensive. There is a requirement for a rapid, sensitive and simple method for detection of the pathogen. A US group has developed a procedure to satisfy these criteria, based on Fourier transform infrared spectroscopy (FT-IR) for rapid detection of *E. coli* O157:H7.

Bacterial cells were separated from the meat using filtration or immunomagnetic separation (IMS) using Dynabeads®. The samples were analysed using FT-IR spectroscopy and specialised software. When cell concentration was at the limit of detection of $\geq 10^5$ CFU/g, a result was possible in 1 hour using filtration, and within 4 hours using IMS. After allowing an additional 6 hours incubation, it was possible to detect *E. coli* O157:H7 in ground beef at a level of 10^1 CFU/g.

The filtration FT-IR method allowed a better estimate of the number of live *E. coli* O157:H7 than the IMS method. The number of live cells could be estimated within a mixture of live and dead cells. The method is being further developed to detect other pathogenic bacteria within foods.

The effect of Smartstretch™ on tenderness of beef topsides and cube rolls

Muscles that are hot boned are free to contract and, during cooling, can shorten to become unacceptably tough. Stretching muscles while they are still on the carcase using techniques such as Tenderstretch has been demonstrated to improve tenderness and consumer acceptability. Smartstretch™ technology has been developed in Australia and New Zealand to laterally compress hot-boned primal cuts prior to packaging, thereby increasing their length to improve tenderness and present a uniform product. The effect of the technology on hot-boned topsides and cube rolls from cows was evaluated by measurement of shear force and meat colour during display.

The *semimembranosus* muscle of the topside was lenghtened by 34%, 41% and 52%, and cube roll by 0, 8.5% and 9.3%. The shear force results for the topside showed that there was no tenderness benefit from increasing the degree of stretch. A smaller stretch of about 20% has previously been shown to improve tenderness compared with no stretching, but it appears that there is no benefit in stretching further. The degree of stretch achieved with the cube roll did not meet the minimum required to produce an improvement in tenderness. There were indications that higher levels of stretch of the topside produced meat that had better colour stability when initially displayed. The major advantage of the technology was considered to be the uniform cylindrical shape of the stretched muscle, which would allow uniform slices to be produced with minimal wastage.

E-mail or post?

We have received a number of requests for the newsletters to be sent out electronically rather than as a hard copy. The newsletters are uploaded each issue onto the website (www.meatupdate.csiro.au). By signing on from the main page link, readers can receive an email notification when the new issues are available for downloading from the website.

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