

# Meat technology-What's new

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## Effect of muscle type and cooking temperature on off-flavour of beef chuck muscles

Some beef chuck muscles that are being prepared as steaks for table meats have a sporadic problem of liver-like off-flavours that limit their acceptability. There is a theory that residual blood haemoglobin is the cause of the liver-like flavour and scientists at a US university carried out tests on five different beef chuck muscles to establish if there was any link between the pigment content and off-flavours.

Steaks from five muscles from the chuck, (*infraspinatus*, *longissimus dorsi*, *serratus ventralis*, *supraspinatus* and *teres major*) were cut into steaks and cooked to an internal temperature of either 71°C or 82°C, and evaluated for liver-like off-flavour by a trained sensory panel. Each muscle was also analysed for myoglobin and haemoglobin concentrations and TBARS as a measure of rancidity.

There was little difference in pigment content of the chuck muscles, except that the *serratus* had significantly lower myoglobin content. The *infraspinatus* was the only muscle for which the sensory panel detected a slight liver-like off-flavour, but there was no relationship to haemoglobin content. Cooking to a higher internal temperature slightly increased the detection of rancid flavours, but this was not reflected in any differences in TBARS values.

It was concluded that this is a complex area and further investigation is required to determine the exact cause of the liver-like off-flavour.

## High oxygen MAP induces lipid and myoglobin oxidation

Modified atmosphere packaging (MAP) with 80% oxygen (O<sub>2</sub>) and 20% carbon dioxide (CO<sub>2</sub>) is used for retail marketing because the oxygen produces an attractive red meat colour and the CO<sub>2</sub> aids in restricting microbial growth. Several studies have shown that the high O<sub>2</sub> level promotes oxidative changes that affect meat flavour and tenderness. Experiments were undertaken to determine the extent to which tenderness and colour are affected, and the biochemical processes involved.

Steaks from the loin (*m. longissimus lumborum* [LL]) and the topside (*semimembranosus* [SM] and *adductor* [AD]) were packaged in either high-O<sub>2</sub> MAP or vacuum, and stored under simulated display conditions for 9 days at 1 to 3°C.

The SM and AD had a greater increase in redness during display than the LL indicating that they might be more susceptible to

myoglobin oxidation, and this was confirmed by TBARS analysis that also showed greater increases in lipid oxidation. Sensory analysis showed that the steaks packed in high-O<sub>2</sub> MAP had lower tenderness and juiciness scores, but higher off-flavour and lower beef flavour scores than samples that were vacuum packed. Biochemical analyses suggested that the decreased meat quality scores for the high-O<sub>2</sub> MAP steaks are due to lipid and myoglobin oxidation and cross-linking of myosin by protein oxidation.

## Effect of post-transport electrolyte-glucose solution on meat quality of young bulls

Cattle that are stressed during transport can produce dark-cutting meat of poor eating quality. Feeding cattle electrolyte solutions has been shown to improve the muscle glycogen content at the time of slaughter. In a Turkish study, 20 eighteen-month-old bulls from the same farm were transported to the abattoir and then divided into two groups. A control group of 10 were held in the abattoir pen for 18 hours and allowed access to water, but no feed; while the remainder were held for the same period, but offered an electrolyte-glucose drink and had access to water. The electrolyte solution contained 0.02% sodium chloride, 0.02% potassium bicarbonate and 0.01% magnesium sulphate in a 5% glucose solution. Each animal drank about 10 L of the solution.

The glycogen content of the *m. longissimus dorsi* measured on samples collected 15 minutes after slaughter was 8.8 mmol/L for the control group and 11.6 mmol/L for the group fed the electrolyte-glucose solution. Although there were no differences in pH between the groups at 15 minutes and 24 hours, the meat from the supplemented group was a lighter, redder colour, had better scores for tenderness, flavour and odour and had higher overall consumer acceptability.

## Effect of enzyme treatment on high- and low-connective-tissue muscles

Enzymes derived from plants, bacteria and fungal sources have long been known to improve the tenderness of meat. Five exogenous (excreted by the organism) enzymes are generally recognised as safe (GRAS) to improve meat tenderness—papain, ficin, bromelain, *Aspergillus oryzae* protease and *Bacillus subtilis* protease. Zingibain, the enzyme from ginger, has also been suggested as a tenderising agent and this, along with the GRAS enzymes, was assessed for effect on tenderness of high- and low-connective-tissue beef muscles.

Two muscles, the high-connective-tissue *triceps brachii* from the blade and the *supraspinatus* (chuck tender) were selected and injected with one of the enzymes, then vacuum tumbled for 10 minutes and rested for 30 minutes prior to being sliced into steaks. The cooked steaks were assessed for tenderness by measurement of the Warner-Bratzler shear force and by a trained sensory panel.

All the enzymes, except ginger, produced an improvement in tenderness of both muscles compared with untreated controls. The papain-treated samples had the largest reduction in shear force. The sensory panel also detected improvements in tenderness due to enzyme treatment, with papain producing the greatest improvement; however, treatment with papain resulted in reduction in juiciness of the *Triceps brachii*. Off-flavours were detected in the ginger-treated samples. There appeared to be no difference in enzyme effectiveness between muscles indicating that the connective-tissue content of the muscle had no effect. Enzyme treatment can increase tenderness by degrading both the myofibrillar and collagenous proteins in the muscle.

## Grain and grass production systems in the USA

The USDA's Economic Research Service 'Livestock, Dairy and Poultry Outlook—June 2010' included a report on grain and grass production systems in the US. Some consumers are willing to pay a premium for products that meet niche market requirements such as natural, organic and grass-fed. These products currently form only a small portion (3%) of the US market for beef, but this portion is growing at a rate of about 20% per annum. Some consumers prefer the flavour of grass-fed beef and it has been shown to have higher levels of the desirable Omega-3 fatty acids.

Early production systems relied primarily on grass but, during the last half of the 20<sup>th</sup> century, grain feeding was introduced and the beef production period was shortened. This resulted in a more tender product with more intramuscular fat or marbling; however, cattle are still raised on pasture for most of their lives before being placed in a feedlot where they are fed a controlled diet of grain, roughage and special supplements such as vitamins, minerals, antibiotics and artificial growth hormones. Generally the shorter term, grain-fed production system has lower feed and ownership costs (land use, interest expense, etc.) than forage-intensive production systems. Contrary to popular perception, the digestion of starches in grains also produces one third to two-thirds lower levels of greenhouse gases than digestion of the quantities of forages necessary to produce the same biological effects in cattle.

Finishing cattle on grass alone requires large quantities of high-quality forages and management skills to produce a consistent product. The producer faces challenges such as lack of high-quality pasture or forage all year round. The beef produced from grass-finishing systems will be leaner, grade lower, have less marbling, yellowish fat colour and produce 15-20% less meat. In a study reported in the 'Outlook', when grain-fed and

grass-fed steers were finished to the same 11 mm back fat, the grass-fed carcasses were 19 percent smaller, took 24% longer to reach the endpoint and had a lower marbling score.

In most cases consumers drive production decisions and, if there is a continued trend towards forage-based production systems, this could lead to a number of tradeoffs. There could be a higher cost of production and reduced supplies. Crop land may have to be converted to pasture and cattle genetically selected for pasture programs.

## Odour-control technology commercialised

A new low-temperature catalytic odour treatment, developed by CSIRO, is to be commercialised by Catalytic Solutions International Pty Ltd. The technology which could be applicable to the meat processing and rendering industries, traps and catalytically destroys foul-smelling sulphur-containing organic compounds. The catalytic converter is made from light-weight, highly porous ceramic which is wash-coated with a catalyst. The odorous sulphur-containing compounds are burnt inside the converter in the presence of the catalyst at temperatures of 80–300°C. A major advantage of the technology is the compact size, which means that control equipment can be installed at the source of the odour, saving the expense of ducting to collect contaminated air and conveying it to a central plant.

## EU to extend COOL to all meat and poultry

The European Parliament has backed plans to extend country-of-origin labelling (COOL) to all meat, poultry, fish and dairy products. Currently only a limited number of products, including beef, are subject to COOL labelling. There are also plans to extend COOL for meat, poultry and fish when they are used as processed food ingredients. There are concerns from the industry that this could prove unworkable as food processors could be forced to constantly alter their labels. The plans have also been labelled protectionist.

## 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](http://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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