

This article first appeared in June/July 2008 issue of The Deer Farmer, published by Country-Wide Publications Ltd, PO Box 529, Feilding, NZ. It is reprinted here with permission.

Keep glycogen levels up

Deer take time to recover from stress

By Eva Wiklund, AgResearch MIRINZ

Research into deer metabolic processes that occur as a result of stress highlight the importance of good pre-slaughter handling for quality of the resulting meat.

There's a strong positive connection between animal welfare and meat quality. Work done to develop better handling routines for slaughter animals, that is, to make these more animal friendly and adapted to natural animal behaviour will lower pre-slaughter handling stress and give better meat quality.

When the pre-slaughter handling goes wrong, animals will be exposed to unnecessary physical and psychological stress. The stress reaction mobilises energy stores (glycogen) in the muscles, sometimes emptying this resource completely. Glycogen is converted to lactic acid in the muscles/meat after slaughter which means that the pH value in the meat drops, a process that takes approximately 24 hours depending on animal species. The pH decline process is for example much slower in beef carcasses compared to deer.

If the muscle glycogen stores are completely or partly depleted before slaughter, the final meat pH will be high and the shelf-life of the meat decreases drastically. A normal ultimate pH value in meat ranges between 5.4–5.7. Values over 5.8 will have negative impact on shelf-life, especially for meat chilled and stored in a vacuum bag, and on meat tenderness.

Low muscle glycogen values at slaughter can be related to pre-slaughter handling stress but also to animals in poor body condition/nutritional status. There are of course clear animal welfare aspects on both of these issues. Animals already in marginal condition do not have sufficient glycogen reserves to withstand further challenges in the form of a prolonged pre-slaughter handling or transport.

So what about leaving the animals to rest for a while if they have been through an extended pre-slaughter handling; that must fill up the glycogen stores and save the meat quality? Unfortunately that doesn't do the trick for ruminants like deer. The whole energy metabolism is very different in ruminants compared to monogastric animals like pigs (and humans), and it simply takes much longer time to fill up the energy reserves in the muscles for ruminants.

Studies in cattle have demonstrated that if their glycogen reserves are emptied, a period of approximately seven days of rest and feeding is required to fill the muscle energy stores back up again. No such studies have been carried out for deer, so it is difficult to say how long time it would take to replenish empty muscle energy stores in deer. But certainly, a few hours or overnight rest in a lairage situation at the abattoir will not improve the muscle glycogen levels.

In attempts to speed up the process of filling up emptied glycogen stores in ruminants, some trials have been evaluating the effects of providing the animals (cattle, Red deer and Wapiti) with electrolytes close to the time of slaughter. The electrolytes would have a similar effect like a sport drink and be very quickly absorbed in the blood stream and then further in the muscles.

Different techniques to deliver the electrolytes have been including them in commercial pelleted animal feeds or mixing electrolytes in drinking water. The theory seems to work, if the animals consume the electrolytes muscle glycogen levels will be replenished faster. But it has been difficult to make the pellets palatable for the animals and of course it is always a challenge to make animals eat or drink in a pre-slaughter handling situation which inevitably involves some stress and an unfamiliar environment.

Measurement of meat pH (approximately one day after slaughter), which is directly dependent on muscle glycogen levels at slaughter, is a good way to measure meat quality since that will give important information about attributes such as meat tenderness, colour and water-holding properties. All these attributes are essential for fresh chilled meat but also for meat used as a raw material for further processing. Meat pH will at the same time give a valuable indication on nutritional status and to whether or not the animals have been exposed to stress before slaughter.

About 10 years ago two comprehensive surveys, which included 3,500 animals each, were carried out in New Zealand and Sweden focused on frequencies of high meat pH values in Red deer, Fallow deer and reindeer venison. The Swedish University of Agricultural Sciences and AgResearch Invermay were responsible for these surveys and the results have been published and communicated extensively to the venison industries (through seminars and popular publications like *The Deer Farmer*) and have also been published in international scientific journals. The very high pH values (above 6.2, so-called dark cutting meat) found in these surveys was most common in reindeer venison (6 % of all carcasses) and less frequent in Red deer (1.5 %) and Fallow deer (1 %) venison.

Specific handling routines that were identified as critical for deer/reindeer in these studies were: yarding and selection before transport, transport conditions (transport time and standard of transport vehicle), and lairage time and conditions before slaughter. In some cases, actions taken to improve labour safety in the potentially hazardous working environment of a meat processing plant can reduce animal welfare and meat quality. Most of the very high pH values recorded in the two surveys were related to problems with these mentioned handling routines but also clearly linked to animals in poor nutritional status.

In both surveys, it was therefore concluded that there are several pre-slaughter conditions that could be improved for deer and reindeer, leading to more consistent venison quality. This is essential because quality attributes influence consumer preference and thereby the economic viability of the venison industries.

The current rules and regulations regarding handling and transport of deer that are in place in both countries included in the mentioned pH surveys (New Zealand and Sweden) are of a very high standard and should safeguard optimal venison quality.

However, the conclusions from these surveys clearly pointed out that there is room for improvement regarding pre-slaughter handling routines for deer/reindeer, and it appears like there has been a lack of R&D activities in the area over the past 10 years. Maybe it is now time to sort out some of those improvements for pre-slaughter handling of deer suggested in the two surveys? The New Zealand and Scandinavian deer industries are already world-leading in setting the standards for deer handling, transport and slaughter so it would be logical to continue this good work, potentially with a collaborative approach.

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