MEAT & LIVESTOCK AUSTRALIA

tips&tools

MSA08 MEAT STANDARDS AUSTRALIA

The effect of pH on beef eating quality

Why is high pH meat a problem?

MSA research has found beef with pH levels above 5.70 to be of lower and more variable eating quality. Accordingly 5.70 has been set as the maximum pH level for MSA grading. In line with eating quality, a slight adjustment is made within the acceptable 5.30–5.70 range, as shown in the table below.

pH reading	Eye round	
	MSA score	MSA grade
5.40	46	3
5.55	46	3
5.70	45	Ungrade

The above data is taken from a standard MSA carcase with the following specifications: HSCW 240kg; male; 75mm hump; AT (achilles tendon) hang; ossification 150; MSA marbling 270; rib fat 7mm; loin temp 7.0˚C; ageing 5 days; cooking method grill and non HGP-treated.

In addition to unacceptable eating quality, high pH meat has the following features:

- It is often known as dark cutting meat, as it generally has a purple appearance.
- A coarse texture.
- Higher water holding capacity (so the meat loses a lot of moisture during cooking).
- Reduced shelf life (bacteria grow more rapidly due to the higher pH and moisture).
- It appears undercooked remaining pink in the centre despite extensive cooking.

Key points

- The acceptable pH for MSA carcases is less than 5.71.
- Eating quality is reduced and more variable above 5.70.
- Dark cutting is defined as carcases with an ultimate pH greater than 5.70. These carcases will generally also have a dark purple meat colour.
- Energy (glycogen) levels in the animal are important in obtaining a pH within the acceptable range.
- Stress or exertion will result in cattle losing energy.

What is the cost of high pH meat?

Carcases that have a high pH, (above pH 5.70) are rejected under MSA grading and are excluded from many meat brands, food service operations and markets.

Due to the eating quality inconsistencies, dark cutting carcases are often heavily discounted.

In Australia 5.1% of cattle MSA graded in 2017-18 had pH levels exceeding 5.70.

The good news is that high pH meat can be prevented. And it's worth it. By improving handling and care in marketing livestock, there are other benefits such as:

- reduced bruising
- improved animal welfare
- reduced weight loss.

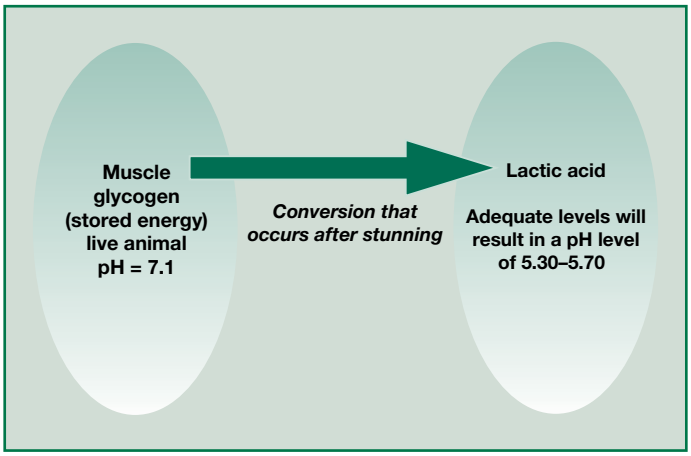
What is pH?

pH is a measure of the acid or alkaline level of the meat. Just as you might measure the acidity of the soil for optimum growth and productivity, MSA measures the acid level of the meat to ensure eating quality. MSA accredited graders measure the pH of the carcase at grading using a pH meter. This measurement is known as the ultimate pH.
pH can be measured on a scale, from 0, which is very strong acid, to 14 which is very strong alkaline.

pH value	Description
14	Strong alkaline
9–12	Common household detergents
7.1	Living muscle (live cattle)
7	Pure water
5.71 – 6.90	**Meat classified as 'dark cutting'; shelf life decreased; not suitable for vacuum packaging; generally darker and tougher**
5.30 – 5.70	**Meat with good visual appeal and potentially good eating quality**
4–5	Orange juice, beer
2–3	Vinegar
0	Battery acid

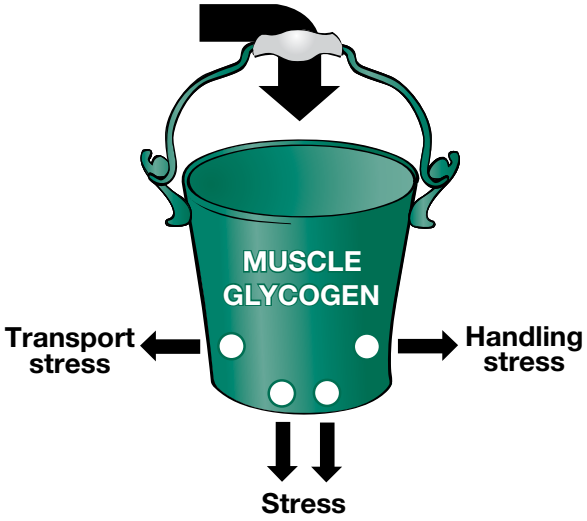
What impacts pH levels in the carcase?

Every animal has a certain amount of energy contained in its muscles in the form of glycogen. Once the animal is dead, the muscle glycogen is converted to lactic acid, which causes the pH to fall. This is illustrated in the diagram below:



The more glycogen there is in the muscle, the more lactic acid will be produced. This will enable the pH to fall to within the acceptable range of 5.70 and below.

If there is not enough glycogen available in the animal, insufficient lactic acid will be produced and the pH will stay high, resulting in dark cutting. This relationship between livestock management, live animal glycogen and pre-slaughter depletion is shown by the 'bucket' diagram below:



Nutrition provided for the animal is the energy into the bucket. The holes in the bucket represent the factors that use up energy such as exercise or stress. These factors will always be present in some form, but it is important to minimise their impact. That is, to keep the 'holes' in the bucket as small as possible.

How are glycogen levels maintained?

Glycogen levels are influenced by the amount and value of the feed that the animal has been eating in the month prior to slaughter. Cattle receiving high levels of nutrition from feedlot rations or first-class pasture will have high glycogen levels. Restricted intake or low quality feed will significantly reduce glycogen, often below the critical level.

How is glycogen lost?

When an animal is exposed to a new environment, unfamiliar sounds or new animals in the social group, they become stressed. They will automatically try to act out one of two basic responses, 'fight' or 'flight'. As soon as either of these responses occurs the glycogen stored in the muscles is rapidly mobilised to enable the animal to either run (flight) or to attack (fight). In the case of severe stress or exertion, the 'holes' in the bucket get bigger and much of the energy is lost. When this occurs it will take a minimum of five days on good nutrition before these energy stores start to be replenished.

Poor mustering or handling during yarding and transport loading dramatically increases the rate of glycogen loss. As energy continues to be lost while animals are being transported and yarded, it is important to minimise the loss by making the transport to slaughter time as short as possible and paying attention to transport, lairage conditions and practice.

Minimising stress caused by adverse weather conditions

Weather extremes also create stress and increase glycogen use. In cold weather cattle expend a lot of energy shivering and maintaining body temperature. Likewise when cattle are hot they will pant and sweat in an attempt to cool through evaporation, again using energy. To minimise the impact of cold weather, cattle should be sold and trucked in good condition. In cold weather feeding pre-transport is particularly important. Wind chill from rain, sleet and wind is often more detrimental than cold temperature alone. If there is a grazier's alert forecast, it might be an option to postpone trucking cattle until the weather has improved.

If the temperature is high, cattle should be trucked at night to minimise the risk of heat exhaustion.

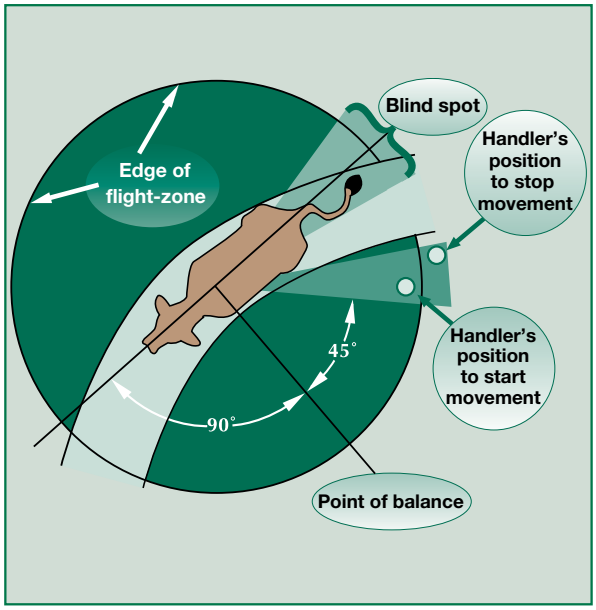
At times of seasonal risk make sure cattle are adequately finished. Cattle are most at risk of dark cutting during autumn or winter when the amount of available pasture is limited. Cattle at this time often have only minimal energy reserves so cold snaps or frost can have a critical effect. The cost of supplementary feeding must be weighed up in comparison with the lost income from dark cutting carcases.

If the cattle are being sold through an MSA underpinned market, the maximum pH allowed is 5.70. Carcases with a pH above this will not be MSA eligible.

Minimising stress by good cattle handling

To minimise the amount of stress when mustering, it is best to avoid using strong enforcers such as electric prodders or dogs. Rattles or flappers can be substituted and will result in less stress for the cattle. Any undue or excessive noise, including loud human voices will also increase stress.

Heifers coming into oestrus (heat) can cause significant stress in the mob by encouraging mounting. A heifer beginning to show signs of oestrus when mustering is likely to go into standing heat on the truck. This is likely to result in an increase in mounting, which will increase stress levels in the mob as well as causing a potential increase in the amount of bruising.



Principle by Dr Temple Grandin, Colorado State University.

Moving cattle easily: the flight-zone

Cattle have wide-angled vision in excess of 300 degrees. They are surrounded by what is termed their 'flight-zone'. Different animals will have different flight-zones depending on tameness and how handlers approach them. To move cattle easily, handlers should work the edge of the circle.
To make the animal move, penetrate the flight-zone. To stop it moving, retreat from the flight-zone.

The point of balance at the animal's shoulder should also be used in moving cattle. Approach an animal from behind the point of balance and it will move forward. Approach it from the front and it will move backwards.

Does meat colour alone indicate eating quality?

Meat Colour is defined as the predominant colour of the rib eye muscle (M. longissimus dorsi). Meat colour is assessed on the chilled carcase at the bloomed rib eye muscle area (M. longissimus dorsi) and is scored against the AUS-MEAT colour reference standards. Meat colour is affected by the amount of myoglobin in the muscle, as well as how well oxygen diffuses in the muscle. In carcases with high pH meat (greater than 5.70) the meat does not allow oxygen to diffuse as far into the muscle causing a dark appearance. However dark meat colour that has an acceptable pH level can also result from an animal that has a large amount of myoglobin, causing the muscle to appear 'redder'. So while high ultimate pH meat and darker meat colour often go hand-in-hand, it is possible to have one without the other.

MSA research has confirmed that along with having no effect on eating quality, consumers do not visually discriminate against meat colours greater than AUS-MEAT MC 3 at the point of sale, where pH is an acceptable level.

While meat colour is not an MSA requirement, supply chains may choose to apply company specifications related to meat colour.

Guidelines to minimise your on farm dark cutting risk

By following these guidelines you will be able to assess the amount of exposure your animals have to the risk of dark cutting. This step-by-step approach will indicate any problem areas that you may not have previously considered. Good management and nutrition are vital in minimising the dark cutting problem.

Step 1: Review past performance. Assess your on farm management and handling practices

- Review past grading feedback results. Look at variation in pH levels.
- Identify financial losses or penalties you have incurred for dark cutting in the past.
- Remember that the maximum pH level acceptable for MSA is 5.70, so it is important to review those that did not meet this specification and think about reasons why this occurred.
- Use your feedback to look at compliance rates over time to identify any trends or problematic times of the year. Was there a seasonal effect?

Step 2: Assess your current on farm management and handling practices

- Using the guideline tables in this publication, tick off those practices you are routinely doing and take note of those you're not. Cross out the ones that don't apply to your operation.
- Summarise and prioritise the practices you need to do. Develop an action plan (what you need to do and by when).

Step 3: Change your practices

- Plan your marketing operations carefully.
- Incorporate procedures in your on farm quality assurance system or management practices.
- Monitor improvements by comparing new feedback sheets with historical ones.
- If necessary, talk to your processor or MSA for further advice.
- Other sources of information to assist in pasture management or supplementary feeding can be obtained from your state Department of Agriculture or Primary Industries or nutritional consultants.
- If supplying cattle to MSA markets, refer to the *MSA Tips & Tools MSA requirements for cattle handling*). All of these requirements are set with the aim of minimising animal stress.

Look at the improvements to your bottom line. Heavy penalties can result from dark cutting carcases. Good management to minimise the potential damage can be a well spent investment.

Key points to remember

High ultimate pH can have a detrimental effect on texture, keeping ability and eating quality.

The following steps can help reduce stress in livestock prior to slaughter:

- Ensure livestock have good nutrition prior to slaughter.
- Muster and assemble stock as quietly and efficiently as possible.
- Handle livestock with care and avoid excessive force and noise.
- Familiarise animals to handling and train stock persons in handling skills.
- Maintain animals in their social groups.
- Ensure livestock have access to water at all times prior to consignment.

For more information

Visit www.mla.com.au/msa or contact MSA 1800 111 672.

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