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DARK-CUTTING BEEF

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Figure 1. Cut surface of normal colored beef above and dark-cutting beef below. (Photographs courtesy of Dr. R. G. Kauffman, University of Wisconsin.)

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When you buy fresh beef you probably use color of lean as a measure of freshness. Most people do. Normal fresh beef has a bright cherry-red color. Beef of this color may turn brownish-red and even green after long storage in the store or in your refrigerator. However, don't confuse brownish-red colored beef with dark-cutting beef.

What Is Dark-Cutting Beef?

The lean of all beef is purplish-red when freshly cut. The surface of normal beef brightens rapidly to a cherry-red color when exposed to air. However, the lean of dark-cutting beef fails to brighten. Dark-cutting beef does not have the normal, bright cherry-red colored lean associated with fresh beef. Instead, it has a dark and sticky lean surface (figure 1).

Dark-cutting beef is frequently confused with the darker colored cow beef. It is also sometimes confused with beef that has been displayed in the retail case too long.

Importance

Dark-cutting beef is important because consumers think of it as something less desirable than the normal, bright cherry-red colored beef. The USDA beef carcass grade standards allow the USDA meat grader to reduce the final quality grade as much as one full grade because of dark colored lean. For example, a carcass qualifying for choice + but showing the dark lean can be graded good +. The economic loss of quality grade (dropped from choice to good) averages $3.50 per cwt. of carcass. (This value ranges from $0 to $10.) Thus on a 600-pound carcass, the economic loss due to dark-cutting beef would be $3.50 x 6 cwts. = $21.00.

Dark-cutting beef is often as palatable as normal beef. Some research shows that dark-cutting beef actually results in a juicier product when cooked because of its higher water holding capacity. Tenderness and flavor of dark-cutting beef and normal beef are usually about the same.

Incidence

The incidence of dark-cutting beef is influenced by many factors. Dark-cutting beef occurs more often in the fall when temperatures fluctuate a great deal within a 24-hour period. The incidence of dark-cutting beef is much higher in slaughter heifers than in steers.

This information was formerly included in Animal Science Fact Sheet 17.

Although no official surveys have been conducted, the author has observed dark-cutting beef in as many as half of a particular lot of slaughter cattle and as few as none. The year-round industry average probably approaches 0.5 percent.

Cause

Dark-cutting beef is caused by a prolonged physiological stress before slaughter. This stress may be caused by unusual moving and mixing of cattle to market and during the marketing process. Showing market animals at a fair where they are housed in strange conditions and mixed with strange animals can cause stress.

The influence of stress has been well documented. For example, when epinephrine (a hormone produced by the adrenal gland during periods of excitement) is administered to steers via subcutaneous injections at 48 and 24 hours prior to slaughter, the subsequent carcasses exhibit the dark-cutting condition.

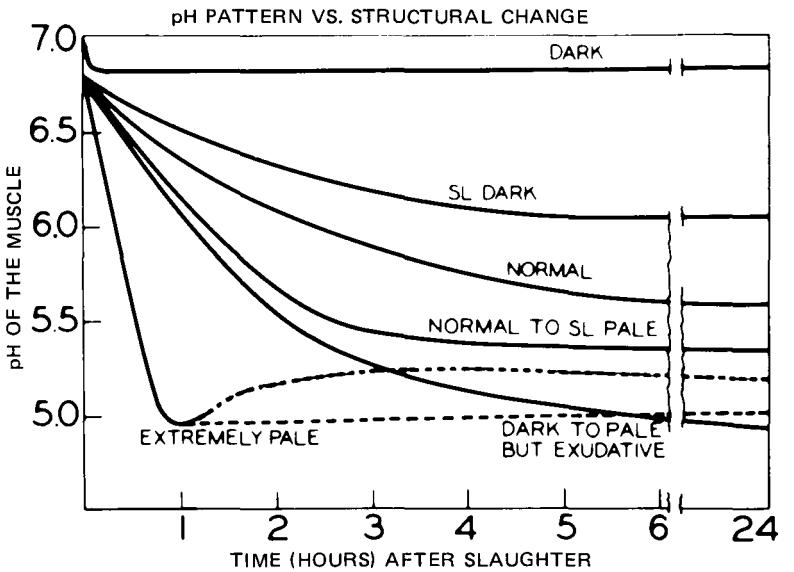

Figure 2. The influence of pH of the muscle after slaughter and at different hours after slaughter upon color of the lean (from Briskey, 1964).

When an animal is slaughtered, the muscle glycogen is converted to lactic acid. Lactic acid in the muscle causes the pH of the muscle to drop after slaughter (see figure 2).

Animals stressed immediately before slaughter call upon glycogen in the muscle and liver to meet muscle energy demands. If they are slaughtered before the muscle glycogen level returns to normal, the excess glycogen is converted to lactic acid, the pH drops faster than normal, and a pale colored lean results (figure 2).

Animals under stress for 24 hours or longer before slaughter will likely use up all of their muscle glycogen because of prolonged muscle energy demands. The result is a low level of glycogen in the muscle at the time of slaughter and thus a low level of lactic acid in the muscle. Therefore, the pH of the muscle will remain high (6.8) at 24 hours after slaughter, and the lean will be dark-cutting (figure 2).

As mentioned previously, all beef is purplish-red initially because the muscle pigment myoglobin is in the reduced state (does not contain oxygen). In normal beef, the reduced myoglobin is oxygenated upon exposure to the air and a bright cherry-red color results. The oxygenation of reduced myoglobin to the bright cherry-red oxymyoglobin is thought to be possible because the role of mitochondria (energy-producing organelles in the muscle cell) in oxygen "consumption" is reduced post-mortem. This is possible because of the drop in muscle pH of normal beef. In dark-cutting beef however, the high pH (see figure 2) is believed to facilitate oxygen "consumption" by the mitochondria, and thus oxygen from the air is not "fixed" to myoglobin to form the bright cherry-red color of normal beef.

Claims that the cause of dark-cutting beef is the extra amount of blood retained in the muscle during slaughter are unproven. Similarly, claims that dark-cutting beef is caused by the feed that the animal eats also are unproven. Inadequate feed intake prior to slaughter more likely may be a cause of dark-cutting beef.

As a producer you should recognize that the intensity and duration of stress as well as the susceptibility of individual cattle to stress will determine the prevalence of dark-cutting beef. For example, some recent evidence has shown that very heavily muscled heifers are more likely to be dark-cutters after a two-day fast than average heifers subjected to the same two-day fast.

Prevention

You can help prevent or reduce the incidence of dark-cutting beef by trying to keep muscle glycogen levels at a normal level at time of slaughter. Preventive measures include:

1. keeping stress and/or excitement to a minimum during mixing and moving cattle to market and during the marketing process.
2. feeding and watering cattle if they must stand for long periods between initial movement from the farm to slaughter, especially during inclement weather.
3. slaughtering cattle as quickly as possible after they leave the farm.
4. selecting cattle for ability to resist or at least adapt to stress during mixing and moving. Research is needed in this area, but research with pigs shows that it is possible to select for stress resistance and thus prevent wide ranges in muscle color.

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