Genetics & heredity in beef cattle

The health of livestock can be influenced by the way that breeds have developed over time. Breeders know that desirable characteristics and traits can be passed on from parents to offspring. Breeders select animals with those desirable characteristics and traits to breed with each other. The practice of selective breeding can have important consequences — both negative and positive — for animal welfare.

"The productivity of domestic livestock... has almost tripled in the last 100 years through the use of both improved feeding methods and genetic selection.... [Some] are concerned that in the future, the most serious animal welfare problems may be caused by overselection for production traits..."

DO YOU KNOW
about selection and breeding systems? Find out what selective breeding, cross-breeding and inbreeding mean in Selection & breeding systems in this inquiry topic. Find out more about artificial insemination and embryo transfer in Reproductive technologies, also in this inquiry topic.

LINKS
Animal welfare issues include the effects of trait selection in livestock. Search an industry publication, such as The Western Producer at www.producer.com, using the search keywords "genetic effects livestock." What concerns about animal welfare do some of these articles raise?

KNOW HOW HEREDITY WORKS
It is important to understand how principles of heredity apply to breeding practices and the results of genetic selection. Cattle breeds raised for beef and milk are different than breeds that were used for agricultural activities decades ago. Many domestic animal breeds have been developed through applications of genetics such as selective breeding.

Selective breeding involves the cross-breeding of two parent animals, each with desirable traits, to produce offspring that carry these desirable traits. Selective breeding in livestock can be carried out by means of artificial insemination and embryo transfer. Selective breeding has benefits, including better resistance to disease and improved nutritional values.

Need To Know: Genetics & heredity in beef cattle

Variations within a breed and between individual animals are influenced by both heredity and environment.

- **Heredity** is the passing of traits from parents or ancestors to their offspring. It is influenced by **genes**, which are biochemical structures made of DNA that reside in chromosomes.

- Chromosomes are passed from both parents to their offspring, therefore passing on genetic material from each parent.

- Since specific chromosomes are passed on randomly, offspring have a unique set of their own chromosomes and a unique combination of traits.

- A gene gives only the potential for the development of a trait. The extent to which this potential is achieved depends partly on the interaction of the gene with other genes.

- However, this potential is also affected by the environment. For example, a person may have a genetic tendency toward a certain body weight. But the person’s actual weight is influenced by environmental factors such as food choices, availability and consumption as well as the exercise that person does. The same general principles apply to livestock breeding.

- The environment can influence such characteristics as weight and muscle, which will vary according to nutrition and exercise.

- An animal’s temperament may also depend on various environmental factors, including nutrition and exercise.

- Accident is another form of environmental influence that can affect an animal’s appearance.

Some of a calf’s characteristics, such as the presence or absence of horns, are based on the genetics passed on from its mother, or **cow**, and father, or **bull**. Each parent contributes half of the genes towards the calf. The presence or absence of horns depends on what is passed on from either parent, and whether these traits are dominant or recessive.

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**DO YOU KNOW**

- that the horns of cattle are routinely removed to decrease the risk of injury to workers and other animals. However, there is strong scientific evidence that all methods of dehorning cause pain. The use of **polled**, or genetically hornless cattle, is a humane alternative to dehorning. Polled cattle are present in all commonly used beef breeds in Canada.

- In some cases, livestock within a breed can be closely related to each other, or **inbred**. Inbreeding can have positive and negative effects on an animal’s health. If a breed’s strengths are passed on to its offspring, more animals within the breed will have these superior abilities. However, there is also a higher chance that **genetic disorders**, diseases or illnesses that are inherited will be passed on from generation to generation.

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**KNOW HOW DOMINANT & RECESSIVE TRAITS AFFECT BREEDING**

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A dominant gene will express itself over a recessive gene. This means that the trait represented by the dominant gene will always be expressed if it is present. A recessive trait will only be expressed if both parents pass on the recessive gene to their offspring. The offspring will now carry two recessive genes. Upper case or lower case letters stand for different genes. Upper case letters stand for the dominant, or “on” gene; lower case stands for the recessive, or “off” gene.

In cattle, the gene that causes horns to grow is recessive. The hornless, or polled, gene is dominant.

As an example, if two polled cattle were bred, their calves would not necessarily all be polled. This is because the parents may have both a dominant and a recessive gene in their genetic profile.

There are three possible expressions for any specific gene.

1. The gene is in dominant form. For example, a dominant polled gene would be written as PP. This means that the calf will be polled, or not grow horns.

2. The gene is in recessive form. For example, a recessive polled gene would be written as pp. This means the calf will grow horns.

3. One allele is dominant while the other is recessive. For example, a gene combination could be Pp. However, because one dominant gene is present, the calf will be polled.
What does the Code of Practice for the Care & Handling of Beef Cattle say about the issue of dehorning cattle?

The horns of beef cattle are routinely removed to decrease the risk of injuries to workers and other animals, and to minimize economic losses due to carcass bruising. The proportion of beef cattle with horns has been steadily decreasing in recent years, as the availability and adoption of polled (hornless) genetics has increased. Most common breeds of beef cattle have polled lines available, and the use of homozygous polled genetics eliminates the need for disbudding or dehorning without affecting productivity. Disbudding and dehorning cause pain and distress for all cattle. Your herd veterinarian is a good resource for information on possible methods of pain mitigation during and after horn removal.

The following requirements are identified in the Code of Practice.

Dehorning must be performed only by competent personnel using proper, well-maintained tools and accepted techniques.

Seek guidance from your veterinarian on the availability and advisability of pain control for disbudding or dehorning beef cattle.

Disbud calves as early as practically possible, while horn development is still at the horn bud stage (typically 2-3 months).

EFFECTIVE JANUARY 1, 2016: Use pain control, in consultation with your veterinarian to mitigate pain associated with dehorning calves after horn bud attachment.

These recommended practices are also provided in the Code of Practice.

a. Use homozygous polled bulls where practical to eliminate the need for disbudding or dehorning.

b. Avoid dehorning at the time of weaning to reduce stress.

Excerpts from the Code of Practice for the Care and Handling of Beef Cattle (©2013) have been used with permission, Canadian Cattlemen’s Association and the National Farm Animal Care Council. www.nfacc.ca/pdfs/codes/beef_code_of_practice.pdf

The process for the development of updated Codes can be accessed through the National Farm Animal Care Council at www.nfacc.ca/codes-of-practice.