

Production of High-Quality Beef—The Nebraska Advantage

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Summary with Implications

Here is a clear description of the Nebraska Advantage in producing high-quality beef: the right genetics, numerous pastures, a multitude of cattle, great water resources, locally-grown corn, the availability of ethanol byproducts for feed, and young cattle that grow fast, with sufficient marbling and subcutaneous fat to ensure tender, flavorful, beef. The science of beef quality supports this production system. The state supports its citizens and agriculture through the University of Nebraska and the Nebraska Department of Agriculture, augmenting the infrastructure. If one could invent an ideal place to produce high-quality beef, it would look much like Nebraska! The impact of high-quality beef production to the state is profound. Nebraska leads the nation in beef produced for the European Union, total beef and veal exports, and commercial slaughter cattle. The economic impact of beef is nearly \$5,500 per person in Nebraska. Sustainable production of high-quality beef is very important to the state.

Introduction

Production of high quality beef requires the right combination of natural resources, people, and infrastructure. Nebraska has ample supplies of each and they combine with the science of beef quality to make our state one of the best places in the world to produce quality beef. Unless otherwise noted, all of the data in this report were derived from public sources published from 2015 to 2017.

Nationally, Nebraska ranks as the top state for commercial cattle slaughter (over 7 million head), commercial red meat production (8 billion pounds, equal to 3.6 billion kg), and the number of cattle on feed. In the U.S., nearly one in four fed

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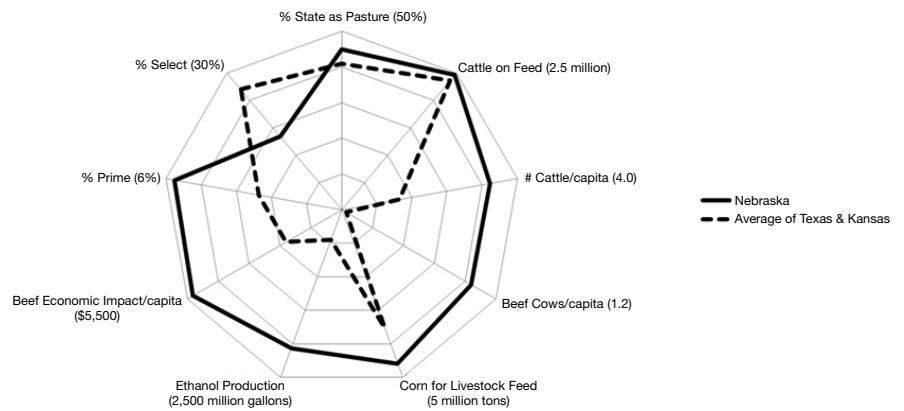


Figure 1. Nebraska versus other top beef producing states (using data from 2012–2017).

cattle comes from Nebraska feedlots.

The next two states for production of fed cattle are Texas and Kansas. Figure 1 shows a comparison of Nebraska to the average of these two states in a number of areas that support beef production. This figure demonstrates the importance of beef production to the state. Evidence of the high quality nature of beef produced in Nebraska can be found in the data that show we produce a higher percentage of Prime (the highest USDA quality grade) and a lower percentage of Select-grade beef than our closest competitors.

Natural Resources

Land

Almost 50% of the state is pastureland. This supports the cows that produce the annual calf crop as well as the calves that suckle and/or graze for roughly 85% of their lives. It explains why Nebraska has far more beef cows per capita than any other state, and 20 to 50 times more beef cows per capita than Kansas and Texas. There are 3.4 cattle per capita in Nebraska, three-fold more than the other top beef producing states.

There is an elevation change of 4,584 ft (ca. 1,400 meters) from East to West

across the state. Annual precipitation totals vary from 16 to 36 inches (40 to 90 cm), meaning Nebraska has a wide diversity of ecosystems to support beef production.

Nebraska farms and ranches utilize 42.5 million acres (18.3 million ha)—over 91% of the entire state. Such large involvement helps to ensure that supporting livestock production in the state remains a high priority. Customers that purchase beef from Nebraska can rest assured that the animals have been raised with the utmost care and that sustainable production practices have been employed to conserve valuable natural resources for generations to come. The year 2017 marks the 150th anniversary of Nebraska being a state. It's not possible to continuously be among the top states in beef production without careful consideration for the ecology and resources of the region.

Water

Nebraska is one of 8 states atop the Ogallala Aquifer, one of the world's largest underground lakes. Beneath Nebraska is almost 3.5 trillion cubic meters of water. If poured over the surface of the state, NE would be covered by 37.9 feet (11.6 meters) of water. Furthermore, we have nearly

24,000 miles (over 38,600 km) of rivers and streams. This precious resource helps Nebraska to withstand short periods of drought, sustaining beef production.

Corn

Water is critical to support crop and animal production. Judicious use of water allows Nebraska to produce ample corn for livestock feed. In fact, Nebraska ranks 3rd nationally in production of corn for livestock feed. The capability of producing animal feed in the same location that the animals are produced means Nebraska has a low cost of production. It is not necessary to transport feedstuffs or animals long distances—a challenge faced by many other states.

Ethanol byproducts

Corn is often converted to ethanol, producing distillers grains. Nebraska research has shown that, pound-for-pound, distillers grains have more nutritional value in cattle feed than corn alone. Nebraska ranks second nationally in the capacity to produce ethanol. Almost one-third of Nebraska corn is directed toward ethanol production. Further, Nebraska beef producers take advantage of corn production by grazing cattle on corn residue, the remains after the corn is harvested and/or the corn plant is converted to silage. The capability to get even more value from this important crop is another valuable, and sustainable, production strategy.

Given the proximity of cattle feedlots to ethanol plants, Nebraska producers can feed distillers grains in the wet form. It is not necessary to dry the grains to minimize transportation costs. Thus, local distillers grains production means a lower cost of beef production.

The combination of cattle, corn, and ethanol form a golden triangle for cattle production.

Cattle

Nebraska has 1.9 million beef cows, about the same as the number of people who live in the state. All elements of beef production can be found within the state.

Cow-calf operators, who raise cows for production of calves for meat, are supported by a seedstock industry that produces the genetic foundation for local producers. Backgrounders take the weaned calves and graze them until they enter feedlots. Relatively mild weather minimizes environmental stress on cattle, compared to states with higher temperatures and humidity. Over 1,500 feedlots are dedicated to caring and nurturing cattle for the final 100 to 180 days they eat corn and corn byproducts (distillers grains) before going to market. In addition, three of the nation's four largest packing plants have operations in the state, as do smaller packing companies.

Breeds

The range in beef tenderness within breeds is almost as large as the range in tenderness among breeds. That said, cattle of *Bos indicus* origin are often less tender than other breeds. They are genetically disposed to this condition due to the amount of naturally occurring enzyme inhibitors within the cell which suppress postmortem proteolysis (tenderization). Nebraska's moderate climate means *Bos indicus* genetics—which are often used to combat high heat and humidity conditions—are seldom found. In Nebraska, 70% or more of the cattle are Angus or Angus-crossbreeds, which are of *Bos taurus* origin.

People

One in four jobs in Nebraska is related to agriculture. In 2015, Nebraska had 47,800 farms and ranches, with an average size of 928 acres (376 ha). Cash receipts from farm marketings exceeded \$23 billion in 2015. Clearly, agriculture (of which beef is the largest segment) is important to Nebraskans.

Cattlemen in Nebraska serve in national leadership positions. The 2016–2017 President of the National Cattlemen's Beef Association hails from the state, as did the 2011–2012 President. One of Nebraska's cattlemen is currently Vice Chair of the Federation of State Beef Councils. Nebraska has, over the years, provided 4 U.S. Secretaries of Agriculture, including the 2005–2007 Secretary. The nation values the leadership of Nebraska beef producers.

Infrastructure

Agriculture is the most important business enterprise in the state, providing \$16 billion in economic activity per year.

University of Nebraska

Residents know that Nebraska is blessed with abundant natural resources. This is complemented by a state investment in infrastructure, including the University of Nebraska and the Nebraska Department of Agriculture. The University has about 3,500 undergraduate and graduate students in the College of Agricultural Science and Natural Resources. Within the Institute of Agriculture and Natural Resources, faculty specialize in Animal Science, Agronomy, Agricultural Economics, Biological Systems Engineering, and Food Science, among other disciplines—many work together to focus on beef. There are almost 300 full-time faculty focused on research with annual research expenditures of \$185 M.

A major research and extension initiative is in beef. Educationally, Nebraska is renowned for the Beef Scholars undergraduate program and the post-graduate Beef Feedlot Management Program. An interdisciplinary program in Grazing Livestock Systems is another innovative educational program, as is the Great Plains Veterinary Education Center. In addition, the university has a strong linkage with the U.S. Meat Animal Research Center, where approximately 35,000 acres and 8,000 cows are used in research projects. These examples of research, teaching, and extension programming demonstrate the significant role the University plays in state-wide beef production.

Nebraska Department of Agriculture

Beef from Nebraska is world renowned for its tenderness and flavor.

For example, in 2005, Nebraska produced 5% of the U.S. beef that was exported to the European Union. For the first 3 months of 2017, it produced 52%. Nebraska is the number one state in the nation for value of beef and veal exports. State investment in agriculture is a consistent theme and great leadership has resulted in international recognition of the Nebraska Advantage.

Organizations

Cattlemen in Nebraska are well organized. They are served by the Nebraska Beef Council, which manages the beef check-off for the state. These funds (producers pay \$1 per head when cattle are sold) are used to support beef promotions, research, and producer education programs. Given the number of cattle in the state, Nebraska provides a significant share of the funds that go into national programs. The Nebraska Cattlemen is an organization with a focus on legislative and policy issues that affect beef producers. Their advice and counsel is valued by representatives to the state legislature and by national cattlemen's organizations.

The Science of Beef Tenderness

Repeat business is based on product performance. The science of beef tenderness helps to explain why beef from Nebraska is among the best in the world.

Tenderness is important. Recent research showed that tenderness explained 81% of the variation in overall palatability ratings obtained on beef steaks across a broad range of marbling scores using a trained sensory panel. Production practices that enhance tenderness help to ensure quality beef.

Tenderness is primarily based on muscle fibers, connective tissue, and marbling level.

Muscle fibers

Muscle cells (fibers) are comprised of overlapping protein filaments. When contracted, the filaments overlap to a greater degree. Consequently, contracted muscles are less tender than those which are not contracted.

When muscle is converted to meat, rigor mortis (death stiffening) occurs. This natural process happens when virtually all of the energy present in the muscle at death is expended. Energy is used to support contraction and relaxation. A muscle in rigor is therefore locked in a state of contraction. From the standpoint of eating quality, it would be best to enter rigor mortis with as little contraction as possible.

Avoid cold shortening-At the packing plant, carcasses are placed in 34 to 36 F (1

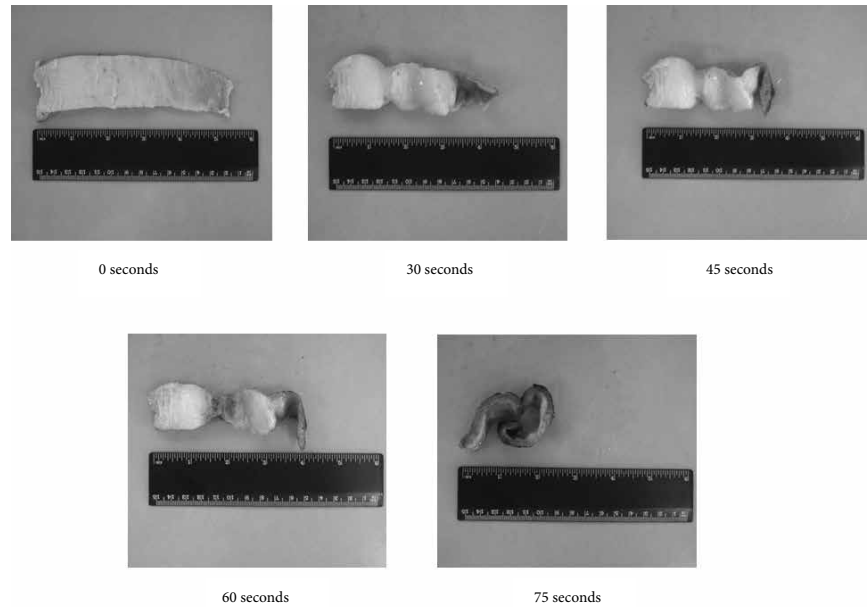


Figure 2. Sequential photos of beef connective tissue after being placed in a hot skillet.

to 3 C) coolers, where they are held until rigor is complete. When pre-rigor muscle is chilled, it shortens. This occurs until the energy is depleted. To minimize shortening, then, chilling should happen slowly (although not slowly enough to compromise food safety). Heavy carcasses have sufficient mass to chill at a slower rate than lighter carcasses. Similarly, carcasses with sufficient subcutaneous fat will not chill too quickly. The Nebraska production system, where young animals are managed for rapid weight gain and fat deposition, minimizes cold shortening and produces tender beef.

Enhance fragility-Also, fragile muscle fibers are more tender. As beef is aged in a cooler, natural endogenous enzymes degrade key proteins and increase the fragility of the muscle fiber. Thus, beef that is properly aged is measurably more tender. The tenderization process continues over many days. Research shows that the bulk of tenderization occurs within about 14 days, although the optimum aging time can vary for each muscle and tenderness continues to improve over longer storage periods.

Connective Tissue

Another structural element of muscle that impacts tenderness is connective tissue. This fibrous tissue, made mostly of the pro-

tein collagen, is easily seen on the exterior of a muscle. The meat industry often calls this silver skin. However, connective tissue is not limited to the surface of a muscle. It surrounds each muscle cell. This is meaningful because when exposed to high heat, connective tissue dramatically shrinks—causing toughness. Figure 2 shows images of silver skin placed in a hot skillet. Photos were taken every 15 seconds. The dramatic shortening that occurs upon exposure to heat can be seen almost immediately and is profound after just 75 seconds.

Unfortunately, connective tissue does not tenderize much during aging so muscles with greater amounts of it are less tender. Muscles that are high in connective tissue are those that are involved in locomotion—like many of those in the round and chuck. High connective-tissue muscles are often marinated in acid-based solutions which helps solubilize the collagen and reduce the impact of connective tissue on tenderness. Slow, moist heating—like in a slow cooker or pot roasting—also solubilizes collagen.

The connective tissue of older animals is less soluble than younger ones, so the younger the animal the more tender the meat. Accelerated production systems, like those found in Nebraska, further contribute to tenderness by minimizing the effect of animal age on connective tissue.

Marbling

Marbling is associated with tenderness. A recent study showed a near linear reduction of shear force and increase in tenderness rating as marbling increased. For that trained panel, 62% of low Choice beef received a positive palatability rating while 82% of average Choice and 88% of high Choice beef received the scores. Prime was even higher at 98–99% positive ratings. Nebraska often leads the nation in the percentage Prime and upper 2/3 Choice. In early 2017, over 80% of the harvest received a Prime or Choice

grade—further evidence of the great job done by Nebraska producers.

Implications/Conclusions

From its natural resources to its people and infrastructure, Nebraska has a competitive advantage in producing high-quality beef. The science of beef quality supports this production system.

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