Grain and Grass Beef Production Systems

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Increasing demand for alternatives to conventionally grain-fed beef products has led to changes in beef production and technologies that support an expanding array of products aimed at niche markets. Attributes of beef production such as antibiotic use, greenhouse gas production, land use and health concerns, are becoming increasingly important to consumers, who may be willing to pay premiums for products that meet their criteria. Beef from production systems alternative to conventionally grain-finished beef—natural, organic and grass-fed or finished—make up about 3 percent of the U.S. beef market and, combined, have grown at a rate of about 20 percent per year for several years, according to a market note published by the industry group, Bord Bia (Irish Food Board). Growth in these alternative beef product markets has survived the economic challenges of the last 2 years. This article compares beef produced through these two broad categories of production technologies: grain-fed versus grass-fed systems.

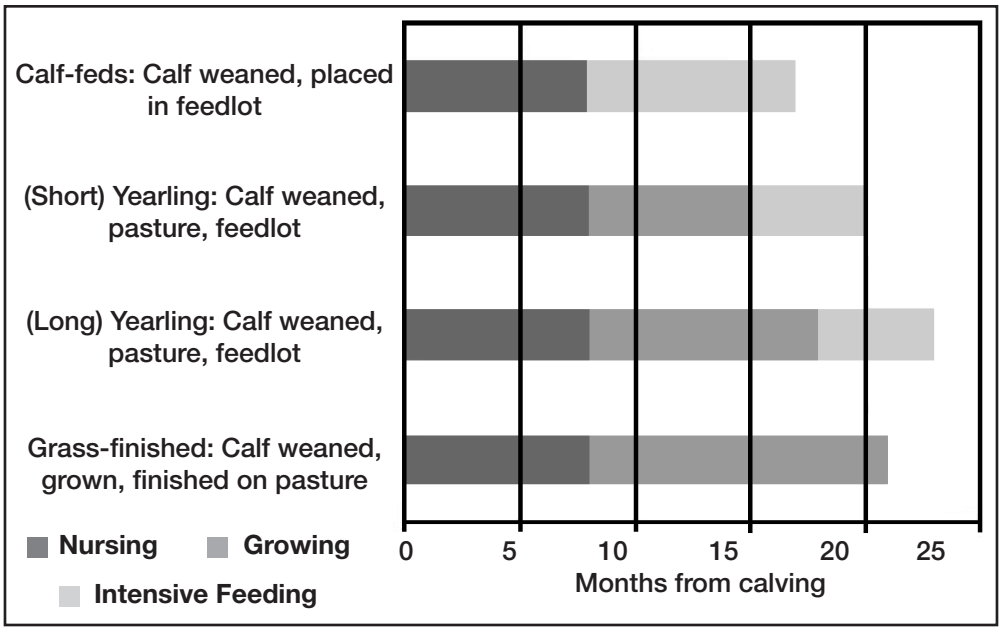
Beef Products Differ by Production System

Beef production in the United States has always been predominantly a forage-based industry. Virtually all beef production systems in the United States require significant amounts of forages or other cellulosic roughage in rations, inputs that have historically been abundant in the form of rangeland, other pastureland not suitable for crops, crop residues and harvested forages. Early Colonial production was primarily from grass-fed 3-to-4-year old cattle, often older spent draft animals. Over time, and as land resources became more intensively used, the introduction of grain feeding—especially during the last half of the 20th century, in part as a way to market abundant grain supplies—shortened the beef production period and resulted in a more tender meat product due to more intramuscular fat or "marbling." Production practices can vary widely even across specific beef production systems. However, cattle are typically raised on range or pasture land for most of their lives and then placed in a feedlot. This is largely because cattle—which are ruminants (animals that have multi-compartmented stomachs)—are very good at converting cellulose, a significant component of all plants, into meat. Most cattle, whether finished with grain or forages, spend at least half of their lives on pasture of some sort (figure 1).

Much of the animal's initial weight gain is through some form of forage and just prior to placement in the feedlot, roughages often account for almost the entire ration fed to a calf, be it pasture, hay, silage or alternative forage. Cattle may enter the feedlot directly after weaning (calf-fed) or may be backgrounded in dry lots (pens) or on pasture ("stockered") prior to placement in feedlots as long or short yearlings (See LDP-M-190, "Southern Plains Cattle Sell at a Premium to Northern-Central Plains Cattle"). Contrary to popular perceptions, the digestion of starches in grains also produces lower levels of greenhouse gases—one-third to two-thirds lower—than digestion of the quantities of forages necessary to achieve the same biological effects in cattle (e.g., Pitesky, Stack-house and Mitloehner, 2009). Production system choices attempt to make the "best use" of regionally and seasonally available resources to produce a high-value commodity acceptable to consumers. For example, in the Southern Plains, highly nutritious wheat pasture, often available during the winter, provides a limited number of cattle a means to gain weight rapidly at a time when most forage plants are dormant. Regardless, in conventional beef production, cattle will be on feed for 120-200 days and gain between 2.5 and 4 pounds per day. A conventionally fed steer at slaughter will have entered a feedlot weighing on average 750-800 pounds, will have left the feedlot typically weighing about 1300 pounds and will have gained about 500 pounds in the feedlot. Fed heifers are marketed weighing 100-200 pounds less. The cattle are fed a scientifically formulated ration in the feedlot that consists of about 80-85 percent grain, distillers grains, and/or other sources of starch/energy, and 10-15 percent hay, silage, or other forage, and the remaining 5 percent will typically consist of a protein-rich meal. These rations are also likely to contain supplemental vitamins and minerals, ionophores (which mimic but are not antibiotics) antibiotics, and artificial growth hormones.

As most feed grains are highly nutritious seeds of grasses that are readily amenable to ruminant diets, feeding grain to cattle after they have had sufficient opportunities to grow on forage-based diets often shortens the period from birth to slaughter, while yielding the largest, highest grade carcasses. Generally, the shorter term, grain-inclusive production systems reduce feed and ownership costs (land use, interest expenses,

Figure 1 - Alternative production cycle timelines for grass-finished versus conventional grain-fed beef production.



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etc.) compared with the more forage-intensive production systems. The longer term, long-yearling and grass-fed/finished systems can incur the greatest ownership costs because they require the most time between birth and slaughter. However, long-yearling programs often result in large carcasses, giving them per-unit advantages over the generally smaller carcasses of grass-fed beef. Calf-feds engender the shortest birth to slaughter period, and at times can incur the lowest costs per unit.

Since most cattle invariably consume forages for most of their lives, whether the production is conventional or not, a distinction must also be made between forage or grass-fed animals and grass-finished animals. Cattle marketed as grass-finished have exclusively grazed grass, pastureland, or other forages their entire lives, and, most importantly, have been fattened solely on grass or forages prior to slaughter. Finishing cattle on grass or forages alone requires large quantities of high-quality forages and operator-management skills to achieve adequate levels of finish to carcasses. Otherwise, grass-fed beef is not substantially different from beef from culled cattle or imported as processing beef. Producers who market high-quality grass-finished beef have removed some of the variances in the product that can result from exclusively forage-feeding an animal, due to differences in genetics, forage type and quality, and/or other management practices. They have achieved a more standard product through careful attention to grazing management and often, by using breeds with certain characteristics or higher quality genetics.

As types and quality of forage fed to cattle affect animal gains and carcass characteristics, much greater management intensity (and cost) is placed on animals that are exclusively finished on forages. The animals must have access to high quality forage, which is not naturally available year-round in most of the United States, particularly during the winter and summer months. In addition, cold temperatures increase the animals' energy requirements to maintain normal body functions. Likewise, reduced feed intake presents a challenge to forage-feeding cattle during warmer temperatures. Forage quality also varies with the growth stage and season of forage plants, whether in situ or harvested.

Beef produced from grass-finished animals is inherently much leaner and does not exhibit the marbling achievable through conventional grain-fed beef production. Although they can grade higher when provided proper forages, most grass-finished carcasses will grade select, produce 15-20 percent less beef, and, most distinguishably, the carcass fat will be yellowish. In one study comparing conventionally grain-fed and grass-fed steers fed to 11 millimeters of back fat, or when pasture availability became limiting in the case of grass-fed steers, grass-finished steer carcasses were 19 percent smaller than conventionally fed steer carcasses, took 24 percent longer to reach the endpoint, and had a marbling score 15 percent lower. Yellow fat results from higher levels of carotene and some lipids in the beef, giving the beef a "gamier" flavor that some consumers prefer. However, grass-finished beef has also been shown to be higher in desirable Omega-3 fatty acids than conventional beef (e.g., Faucitano et al., 2008; Leheska et al., 2008). Grass-fed beef production is often readily amenable to natural and organic production systems because cattle not in confined quarters often require fewer dietrelated antibiotics to remain healthy.

Some grass-fed/finished beef is produced—and certified in the case of organic beef—without the use of ionophores, antibiotics or artificial growth hormones. Meat from each production system meets the preferences of some consumers. Taste panels generally characterize beef from cattle finished on grain-based diets as having a milder flavor and brighter color and as being more tender than grassfed/finished beef. Fat in beef generally contributes to the tenderness of the product, primarily due to increased marbling that also carries the flavor in the meat most consumers prefer (e.g., Brewer and Calkins, 2003; Sitz et al., 2005). Producers of grass-finished beef, however, can often obtain premiums for their products—as can producers of natural, certified organic beef and other niche-targeted programs—due to consumer tastes and preferences for grass-finished beef and willingness-to-pay.

Implications for Beef Production and Consumption

Grass-fed beef production technologies offer producers attractive, commercially viable alternatives to conventional grain-fed beef production. Each production alternative supplies a product with slightly different attributes preferred by an increasingly diverse array of consumers. However, at some point, and with continued growth in niche-market demand, the decision to pursue grass-finished production could begin to necessitate a number of tradeoffs. The direction many of these tradeoffs suggest is toward higher cost of production and reduced beef supplies. For example, it could become necessary to liquidate some cows to make room for grass-finishing programs, reallocate cropland to provide the necessary high-quality forages, and vary selection programs to tailor cattle genetics amenable to alternative beef production technologies. Already, providing locally sourced beef is straining slaughter capacity—e.g., supplies—in some local areas. Generally, because they lack the means to do so, local meat processors are less likely to salvage the full array of byproduct values than larger packers, thus reducing supplies of intermediate inputs to a number of industries such as pharmaceuticals, cosmetics, and lubricants. Because byproducts contribute significantly to packers' profit margins, this also makes it necessary for small processors to bid less for market-ready cattle. As in most cases, consumers drive production decisions, and as consumer preferences continue to shift toward products from more forage-based beef production systems, solutions will need to be found to many actual or anticipated short-term constraints on producing the desired final beef products.

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