Technological Innovation and Competitiveness of Production Systems:

"Intensive production systems for differentiated markets"

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Table 1 shows U.S. beef cattle statistics published from the United States Department of Agriculture. The retail equivalent value of the U.S. beef industry in 2005 was $79.5 billion. This value has steadily increased. The total U.S. consumption of beef was 12.6 billion kg that was produced from 32 million head of cattle harvested (27 million steers and heifers, and 5 million cull beef and dairy cows). The consumption of

Table 1. United States Beef Cattle Statistics in 2005.

Retail equivalent value of U.S. beef industry, $	79.5 billion
Total U.S. beef consumption, Kg	12.6 billion
Value of U.S. cattle and calf production, $	36.7 billion
Carcass weight of U.S. beef production, kg	11.2 billion
U.S. Beef Exports	
Carcass weight, Kg	316 million
Value, $	973 million
Percent of production	2.8%

USDA Beef and Cattle Industry Statistics

beef by Americans has remained relatively constant over the last 5 year period. Although our export markets were closed for sometime during this era, cattle prices in the U.S. have gradually increased largely due to the supply and demand for beef. Cattle producers have been receiving record prices for calves that are ready to enter the nation's feedyards. In 2005, beef production was down by approximately 9% compared to 2002 statistics. The U.S. beef exports decreased from 9% of production in 2002 to 2.8% of production in 2005. Expect this trend to reverse.

Beef cattle in the above statistics were produced utilizing a combination of extensive and intensive production systems. Our industry is divided into three distinct production segments. These are 1) beef/cow calf producers, 2) stocker/back-grounding operators and 3) beef cattle feedlots. Beef cow calf production systems in the U.S. are extensive production systems and producers are generally very independent of each other. As weaned cattle begin their migration across the country in backgrounding/stocker production systems, livestock management becomes more intensive until they reach the nations feedyards where significant technology advances have been made and implemented. Traditionally, the cow/calf, stocker, and feedlot sectors of the beef industry in the United States have been independent from each other. Today, there is more integration than ever before in these sectors allowing greater amounts of technology to be economically implemented into cattle production systems throughout the animals lifespan. However, there is still significant independence between these sectors in U.S. beef production. In today's industry, cattle may change ownership a number of times

from birth to harvest. As ownership changes, It is less likely that technology will be implemented into is into a particular sector unless cost of the implemented technology can be recovered in that sector.

One of the major issues in cattle production in the U.S. is animal identification throughout the production chain. Great strides have been made in tracking cattle from birth to harvest during the last 5 years and progress continues to be made. As management systems are put in place to trace animals and identify the technological advances that have been utilized in cattle, value added production practices in the cow/calf sector can be more easily transferred through the production systems. The way cattle are marketed in the U.S. is changing. As marketing strategies continue to change more profit will be realized in the development and production of value-added products in the beef industry.

The majority of the 27 million steers and heifers harvested in the U.S. are harvested after intensive feeding practices of high energy diets in the nations feedyards. The feedyards are highly concentrated in the Midwestern and Southern Plains states. Of the cattle fed in feedyards, approximately one third are harvested from feed yards in the Southern Plains consisting of the Texas panhandle, Western Oklahoma, Southwest Kansas, Southeast Colorado and Eastern New Mexico. Environmental conditions in this area are conducive to intensive concentrated animal feeding operations. The average rainfall is less than 50 cm per year with a moderate climate. During much of the year evaporative losses from the pen surface result in pens staying relatively dry. However, during extreme hot and dry summers, dust can be a problem. The average size feedlot in this area consists of approximately 40,000 head capacity. Cattle enter these feed yards weighing approximately 340 kg and are harvested at approximately 560 kg live weight. Cost of gain in a is approximately $1.14/kg during a 120 to 140 feeding period. While in the feedyard, cattle are fed high concentrate diets with an average of 13.5% crude protein consisting of processed corn grain, protein/vitamin/mineral supplements, and 5 to 10% roughage. In the Southern plains feedyards, the majority of the grain used in feedlot diets is produced in the mid-west in the Corn Belt. This grain is transported to the site of feeding via rail. Grain production in the Southern Plains requires significant irrigation due to the relatively low rainfall, especially in summer months, making grain transported from the Corn Belt more economical in relation to feeding local grain. A significant amount of the corn production in the vicinity of feedyards is harvested as silage to provide the roughage component of the diets.

Significant technological advances have been made beef production during the last 20 years resulting in increased efficiency of feed utilization and reducing cost of production. We have moved from feeding management and dietary strategies requiring 8 units of feed/unit of gain to less than 5 units of feed/unit of gain in present day feedyards. This improvement in production efficiency occurred due to changes in feeding management, livestock management and genetics, and utilization of technology including feed additives. Technology advances have come from changes in feed formulation to utilize degradable and undegradable protein, grain processing techniques/technology, feed bunk management, anabolic growth implants, phase or program feeding, and the addition of numerous feed additives to the diet. Unless targeted by a specialty feeding/management program, the majority of feedlot cattle in the U.S. receive an anabolic implant and a dietary ionophore as a minimum amount of technology.

However, most cattle fed in the U.S. receive a significant amount of other specialty nutrients/feed additives in the feeding program.

Starting cattle on feed and maintaining optimal feed intake requires a great deal of management. Nutritionists continue to push cattle harder and harder with high starch energy diets. Cattle are often approaching sub-clinical cases of acidosis. In my research, I have found that the inclusion of Saccharomyces cervisae (P7 and BIOSAF) into the diet at a rate of 5 to 20 g/day was advantageous in maintaining intake in starter diets. Our data suggests that the mode of action is likely related to a shift in fermentation characteristics that maintains a higher ruminal fluid pH.

An issue facing high intensity U.S. beef cattle production in the nation's feed yards is the impact of concentrated beef cattle feeding operations on the environment. Concentrating beef cattle in feed yards can result in significant amounts of manure waste containing N and P that if escapes to the environment uncontrolled, can create a hazard. Approximately 2 kg (dry matter basis) of animal manure is deposited on the pen surface per head daily. Many nutritionists are working on the development and implementation of technology that reduces the amount of N and P excreted in the waste of feedlot cattle. Improvements made in feed conversion and nutrient utilization over the past years has significantly reduced the amount of N and P that is excreted to the environment. Fertilization and crop management practices have also improved the mining of these nutrients from the soil and environment. However, efforts must be continued on the development of technology that can improve nutrient utilization and subsequently, reduction of N and P loss to the environment from beef cattle feedlots.

Niche markets for beef products in the U.S. may change production practices. The American consumer requesting the production of 'natural' or 'organic' products continues to rise. Survey's conducted in the U.S. on consumer preference suggest that approximately 22% of our consumers prefer the taste of forage fed beef over the traditional grain finished beef. Economic data from my colleagues, Dr. Walt Prevatt and Dr. Chris Kerth at Auburn University indicates that the cost of beef production in the U.S. is greater when beef is produced from grazing forages as compared to feeding in the concentrated beef cattle feedyards. They showed that the break-even cash price for finished cattle was $1.57/kg vs. $1.51/kg for forage finished vs. feedyard finished, respectively. When grain was used to supplement the finishing of cattle on forage, the break-even cost rose to $1.82/kg. Incorporation of cost effective technology into grazing programs may result in the production of a more cost effective product for the marketplace. Our research shows that adding 10 g/head/day P7 in a free-choice mineral supplement to the diet of cattle grazing dormant native forages increased the ADG by 0.1 kg/day. Other research suggests that the mode of action for this response is likely an increased rate of forage digestion; thereby, increasing the potential for greater forage intake. We are currently testing this hypothesis by determining the rate of digestion of various forage types in cattle fed different strains of Saccharomyces cervisiae.

Some considerations to consider when feeding cattle for the U.S. market may include age and breed of animal, and sex, Age of the animal has a significant effect on the composition and efficiency of gain of cattle in the finishing period. Cattle that wean calves heavy enough to go directly on feed without entering a stocker program generally produce beef from birth to slaughter more efficiently. Finishing cattle at a younger age reduces the daily maintenance cost of production. However, yearlings generally have a

higher ADG and lower number of days on feed than their younger counterparts. When considering efficiency of production, steers always produce a greater efficiency of gain than their heifer counterparts do. Feeding fat cattle for the U.S. market requires approximately 1 cm of back fat in order for cattle to grade properly. As cattle continue to fatten, efficiency of gain reduces significantly. Therefore, price spreads between USDA Choice and Select plays a significant role in how economically efficient it is to feed cattle to higher finish endpoints. In the U.S., we have realized a significant rise in the use of continental breeding in our herds. This has added size and muscling to the carcass while reducing fatness. Unfortunately, this may mean feeding cattle to higher finish weights to fit within an acceptable grade for key valuable retail cuts.

Feeding cattle in today's environment of competitive pricing, global economy and alternative lifestyle choices makes beef cattle feeding management even more challenging that ever before. Incorporation of available and economic technology to improve the economic efficiency of production is necessary to maintain a competitive edge. Continual testing and evaluation must be done to identify the technology that will be incorporated into beef cattle feeding systems in the future.