FEEDING NATURAL CATTLE IN FEEDLOTS

Mark Corrigan
Lallemand Animal Nutrition

INTRODUCTION

Recent trends in consumer demand have created a market for beef produced from "Natural" cattle. The term natural is one that is not very well defined, but generally refers to cattle that have been produced using a set of guidelines put into place by a process verified program. Process verified programs generally require certification documents that provide information about the animal that often includes the age of the animal, source of the animal, and some level of documentation about the production practices used during the animal's life. In terms of attitude toward natural production programs, beef producers generally fall into one of three categories:

1. Believers - This group believes there is a definite benefit to the consumer when beef cattle are produced using the verified process of a particular program or programs. This group of producers will produce natural cattle exclusively.

2. Opportunists - This group has no real objection to natural cattle production, and sees it as a marketing opportunity to get a premium for the beef animals they produce. This group will produce natural cattle when it is economically advantageous to do so.

3. Opponents - This group feels it is necessary to produce food using the most efficient methods possible. This group refuses to produce natural cattle even when it is economically advantageous to do so.

It is beyond the scope of this paper to discuss the potential human risks associated with current conventional beef practices. Therefore, this paper was written with the opportunists and believers in mind. The economics section was created to help the opportunists determine if natural cattle production will fit into their operation and the other sections were created to help both the believers and opportunists increase the economic return to their operations.

WHAT IS NATURAL BEEF?

The terms Natural and Organic are often confusing because of the wide range of programs that use them. Below are the USDA definitions of some of the more common label claims used by these programs (USDA, 2006), but the reader is strongly urged to contact personnel within the particular program one is considering to ensure that all requirements are met.

Natural: A product containing no artificial ingredient or added color and is only minimally processed (a process which does not fundamentally alter the raw product) may be labeled natural. The label must explain the use of the term natural (such as - no added colorings or artificial ingredients; minimally processed.)

No Hormones (beef): The term "no hormones administered" may be approved for use on the label of beef products if sufficient documentation is provided to the Agency by the producer showing no hormones have been used in raising the animals.

No Antibiotics (red meat and beef): The terms "no antibiotics added" may be used on labels for meat or poultry products if sufficient documentation is provided by the producer to the Agency demonstrating that the animals were raised without antibiotics.

Organic: For information about the National Organic Program and use of the term "organic" on labels, refer to the factsheets from the USDA Agricultural Marketing Service. The guidelines for USDA Organic are much more extensive than the latter three labeling requirements.

PURCHASING AND RECIEVING NATURAL CATTLE

Ensuring that the appropriate signed affidavits are acquired for the specific program the cattle are to be marketed in is of utmost importance when purchasing natural cattle. Premiums for natural feeder calves have exhibited great variation and depend on market demand when the cattle are purchased. While not required, it is strongly recommended that cattle purchased for a natural feeding go through a preconditioning program prior to arrival at the feedlot that covers: weaning, castration of bull calves, dehorning, an aggressive vaccination program that includes vaccination for bacterial respiratory pathogens, and a proper nutrition program that includes bunk feeding. Generally, groups of calves that contain cattle from more than one source should not be purchased for a natural program unless they have been commingled for a period greater than 60 days prior to feedlot arrival and even then there is likely greater risk associated with those calves. Establishing a relationship with natural calf producers is recommended when there will be long term participation in a natural program. This will allow a feedlot to identify sources of cattle that are properly managed prior to arrival at the feedlot.

Maintaining the health of natural and organic cattle is paramount to the economic feasibility of their production. When an animal purchased for a natural program becomes sick and requires treatment, it represents a significant economic loss in the form of opportunity costs associated with withholding technologies such as implants, ionophores, and antibiotics prior to the disease event, as well as a loss of the premium paid to purchase the natural animal. Several of the recommendations below are simply good cattle management practices, but their importance is increased in a natural program where a disease outbreak can represent an even greater economic loss when compared to cattle managed using conventional methods.

Nutritional management of the cattle once they arrive at the feedlot is of utmost importance and should be carried out under the guidance of a qualified nutritionist. The stress caused by a poorly managed nutrition program can increase the likelihood that an animal will succumb to infection, especially during the stressful receiving period in the feedlot. Additionally, ruminal acidosis can stimulate an inflammatory response (Danscher et al., 2010; Khafipour et. al, 2009; Gozho et al., 2005) which may contribute to an exaggerated response to pathogens in the animal ultimately leading to clinical disease. Dietary roughage level is often increased in natural cattle diets because the lack of an ionophore in the diet can increase the chances of digestive upsets;

however, this practice is not universal as increasing the roughage component of the diet will decrease the energy concentration ration.

Because antibiotics cannot be used in most natural programs, the best animal health strategy is prevention of exposure. Several measures can be taken to isolate natural cattle and limit their exposure to harmful bacteria and viruses including:

1. Proper sanitation of handling facilities prior to and after handling cattle.
2. Frequently changing needles when injections are given to multiple calves.
3. Making certain that equipment used to handle feed is not used to handle manure.
4. Placing natural cattle in pens that limit or eliminate exposure to runoff drainage from other pens.
5. Eliminating the practice of using a single fountain to supply water to multiple pens.

ECONOMICS OF NATURAL CATTLE PRODUCTION

Because growth promoting technologies are generally not allowed in natural production programs, there are opportunity costs associated with not using these technologies. These costs must be considered when one is making the decision about the economics of feeding natural cattle. While the overall cost of not using these technologies can be hard to determine, Lawrence and Ibarburu (2006) used a meta-analytical approach to determine what the per head dollar value of current conventional technologies were in the United States (Table 1). It should be noted that the model did not take into account the additional cost for the technologies, so the actual product costs should be subtracted from the figures when making production decisions. Overall the lost opportunity cost from eliminating the technologies was $122.06 per head, and increased the breakeven price by 11.61%. These opportunity costs will increase when feed costs increase.

Table 1. Average improvement associated with conventional technologies.[1]

Technology	ADG Improvement	Feed Efficiency Improvement	Breakeven Price Increase Without	Opportunity Cost per Head
Implants	14.1%	8.8%	6.52%	$68.59
Ionophores	2.9%	3.6%	1.18%	$12.43
Sub-Therapeutic Antibiotics	3.4%	2.7%	0.56%	$5.86
Beta-Agonists[2]	14.0%	12.6%	1.24%	$13.02
De-wormers	5.6%	3.9%	2.11%	$22.16
		Sum	11.61%	$122.06

[1] Adapted from Lawrence and Ibarburu, 2006.
[2] ADG and feed efficiency improvements reflect their impact only during the time they are fed.

One area that is not included in this analysis is bacterial and yeast derived direct-fed microbials and prebiotics. It is generally thought that these products should be considered as replacement technologies for antibiotics and ionophores. However, data generated from studies using yeast direct-fed microbials suggests that a synergy exists between them and some conventional technologies. For instance, certain yeast strains have been shown to have beneficial effects on ruminal lactate metabolism (Chaucheyras et al., 1996) and therefore may have some benefit in

preventing ruminal acidosis. Because of this, these technologies are often used in natural diets as replacements for ionophores to alleviate digestive upsets. However, a recent meta-analysis indicated there maybe synergistic effects when feeding certain strains of *Saccharomyces cerevisiae* and monensin (Table 2). Cattle fed monensin + *S. cerevisiae* had 3% greater average daily gain and 4% better feed efficiency when compared to cattle fed monensin alone. In studies where monensin was not included in the diet, cattle fed *S. cerevisiae* still had 3% greater average daily gain, but there was a numeric increase in feed intake that led to the improvement in feed efficiency only being 2% greater in cattle fed the live yeast. In both cattle fed monensin and cattle not fed monensin average daily gain was 3% greater in cattle fed *S. cerevisiae*, but monensin appears to act as an intake limiter even when fed in conjunction with live yeast. This potential synergy represents an additional opportunity cost when considering feeding natural cattle.

Table 2. Effects of *Saccharomyces cerevisiae* in beef cattle diets containing monensin.

Item	Studies	Monensin Only	Monensin + SC-1077	*P*-value[1]	Improvement
Dry Matter Intake	7	21.2	21.1	NS	-0.4%
Average Daily Gain	8	3.06	3.15	< 0.01	3.0%
Feed:Gain	7	5.84	5.61	< 0.01	4.0%

[1] NS = not significant.

REPLACEMENT TECHNOLOGIES IN NATURAL PROGRAMS

Conventional beef cattle growth promotant technologies can generally be categorized as follows:

1. Antibiotics - i.e. chlortetracycline, oxytetracycline, etc.
2. Rumen modifiers - i.e. ionophores
3. Physiology modifiers - i.e. hormone implants, beta-agonists, and estrus suppressors.

True replacement of these technologies is difficult because of their generally high degree of efficacy. Most live yeast, live bacteria, and yeast derived products contain either live organisms that are naturally occurring or yeast derived products that are from naturally occurring yeast, so they are allowed in natural programs. In order for these products to be used in organic programs, they must be produced by a process that meets certain standards and the product must be certified organic. Additionally, products should be scrutinized very carefully to ensure that it is produced with a rigorous quality control program. Doses and strains of live micro-organisms contained in the product should be on the label so that the viability of organisms can be verified by a third party lab. Additionally, the doses and strains of the organisms should be compared with what was used in the supporting research for the product to ensure that the research applies to the actual product. Some direct-fed microbial labels are rather ambiguous as to what the product actually contains. If the product is not a live organism, assurance of quality control of the product is necessary by giving some measure and guarantee of the active ingredient(s). Responses to probiotics and prebiotics have been inconsistent, and in the authors opinion some of the inconsistency in responses is likely due to inconsistency in the products. Additionally, there is a great deal of variation in strains of yeast and bacteria even within the same species

(Newbold et al., 1995; Parrot et al., 2001). Therefore, products must be selected that contain tested strains of yeast and bacteria for a particular purpose.

The antibiotics used in beef production today are very effective, but there are some strategies employing certain direct-fed microbials and prebiotics that may have an impact on animal health. These products will generally work through one or more actions including: competitive inhibition of pathogens, stimulation of competing organisms, production of bacterocins, production of acids, attachment to binding sites on tissues, and neutralization of bacterial toxins. Some studies have shown a decrease in cattle requiring treatment for respiratory disease after feeding a strain of *S. cerevisiae* subtype *boullardii* (Keyser et al., 2007). Keyser et al. (2007) also observed an increase in intake in cattle fed *S. cerevisiae boullardii* when stress was induced by giving an injection of florfenicol. Similarly, yeast cultures have been shown to increase intake in dairy cows (Wholt et al., 1991). Products containing yeast cell wall components that have a high concentrations of mannans and β-glucans may also be useful in reducing the intestinal pathogen load of an animal because mannans have been shown to bind certain flagellated bacteria (Sharon and Lis, 1993) and β-glucans have been shown to be stimulatory to the immune system (Akramienė et al., 2007). The majority of bacterial direct-fed microbials that are used to promote improved gut health contain lactobacilli, with *Lactobacillus acidophilus* being the most commonly used organism. Generally speaking, these direct-fed microbials may improve the overall health of high-stress animals if the disease challenge isn't too severe, but the data for any particular product should be reviewed to determine the appropriateness of the product for the application.

The most commonly used rumen modifier in conventional beef cattle production is the ionophore monensin. This ionophore controls feed intake by limiting daily intake variation (Cooper et al., 1997). The altering of feed intake behavior by monensin can have positive impacts on rumen pH and reduce the incidence of acidosis (Cooper et al., 1997). Because ionophores generally aren't allowed in natural cattle programs, alternative strategies must be employed to prevent digestive upsets in cattle. Some live yeast strains have been shown to stimulate lactic acid utilizing bacteria such as *Megasphaera elsdenii* and *Selenomanas ruminantium* in pure culture *in vitro* studies (Chaucheyras et al., 1996). Additionally live yeast competes with lactate producing bacteria in the rumen (Dr. Nicola Walker, unpublished data), and both of these actions appear to explain the increase in rumen pH observed by Bach et al. (2007) in dairy cows fed live yeast. The mode of action of bacterial direct-fed microbials is generally not well defined. It has been hypothesized that lactic acid producing bacteria may cause a "tonic" effect on lactate utilization in the rumen by stimulating the growth of lactic acid utilizing microbes in the rumen. However, this hypothesis has not been definitively proven. One bacteria whose effects in the rumen have been extensively studied is *Propionibacterium freudenreichii*, which is a lactate utilizing bacteria that also produces propionate (Parrot et al., 2001). Because of its utilization of lactate, *P. freudenreichii* may also have an impact on rumen acidosis and increase the concentration of propionate in the rumen.

The author is not aware of any existing technologies allowed in natural programs that could be considered replacements for physiological modifiers. While leaving males intact would increase their rate of gain and feed efficiency similar to that of a steer give hormonal implants (Calkins et al., 1986), most packers will not grade bulls and the seller will be discounted heavily.

Melengestrol acetate is a synthetic progestin often used to suppress estrous in feedlot heifers, thereby controlling riding behaviors in pens that can be detrimental to feedlot performance. One possible strategy for eliminating riding behavior in natural heifers would be ovariectomization. However, ovariectomized heifers typically gain slower and are less efficient than their intact counterparts unless they are implanted with the proper hormones (Kelzer et al., 2010).

THE USE OF DIRECT-FED MICROBIALS TO MITIGATE *ESCHERICHIA COLI* O157:H7 SHEDDING IN THE FECES OF FEEDLOT CATTLE

Meat from most natural cattle feeding programs is sold under a branded name. The possibility of a meat recall or human illness associated with a branded beef product represents a risk to the value of that particular brand. Therefore, several natural cattle feeding programs require that cattle are fed an approved direct-fed microbial for a period of time prior to slaughter in order to reduce the shedding of pathogens, specifically the human pathogen *Escherichia coli* O157:H7. Most if not all of these approved direct-fed microbials will contain a strain of *L. acidophilus*. Chaucheyras-Durand et al. (2006) observed that *L. acidophilus* inhibited growth of *E. coli* O157:H7 in vitro in rumen cultures. In that study, the response was dose dependent, with the high doses having a greater effect. Furthermore, Tabe et al. (2008) observed that cattle fed a strain of *L. acidophilus* were almost three times less likely to shed *E. coli* O157:H7 in their feces when compared to cattle fed no direct-fed microbial. It is important to note that different strains of *L. acidophilus* will differ in their ability to inhibit *E. coli* O157:H7 (Brashears et al., 2003).

TAKE HOME MESSAGES

When conventional practices are eliminated from beef cattle production, there is an economic cost associated with not using those technologies. The premium received for cattle fed using natural and organic protocols must cover the opportunity costs associated with not using conventional technologies, as well as take into account the additional record keeping and labor associated in order to be economically advantageous for producers. There are several biosecurity measures and alternative technologies that can be employed to help recover some of the opportunity cost of natural programs. However, these technologies are much less regulated than conventional growth promotant technologies, and therefore scrutiny of the quality control measures taken by the company producing the product as well as a thorough review of the supporting data for the product to make certain that it is applicable.

LITERATURE CITED

Akramienė, D., A. Kondrotas, J. Didžiapetrienė1, and E. Kėvelaitis. 2007. Effects of β-glucans on the immune system. Medicina (Kaunas) 43:597-606.

Bach, A., C. Iglesiasc, and M. Devant. 2007. Daily rumen pH pattern of loose-housed dairy cattle as affected by feeding pattern and live yeast supplementation. Anim. Feed. 136: 146-153

Bargen, J., R.A. Ames, L. Dussert, E. Chevaux, and R. Mass. 2009. Measuring Performance Effects of Live Yeast Across Diverse Production Scenarios. Lallemand Animal Nutrition Technical Paper.

Brashears, M.M., D. Jaroni, and J. Trimble. 2003. Isolation, selection, and characterization of lactic acid bacteria for a competitive exclusion product to reduce shedding of *Escherichia coli* O157:H7 in cattle. J. Food Prot. 66:355-63.

Calkins, C.R., D.C. Clanton, T.J. Berg, and J.E. Kinder. 1986. Growth, Carcass and Palatability Traits of Intact Males and Steers Implanted with Zeranol or Estradiol Early and throughout Life. J. Anim. Sci. 62:625-631.

Chaucheyras F., G. Fonty, G. Bertin, J.M. Salmon, and P. Gouet. 1996. Effects of a strain of Saccharomyces cerevisiae (Levucell SC1), a microbial additive for ruminants, on lactate metabolism in vitro. Can. J. Microbiol. 42:927-33.

Chaucheyras-Durand, F., J. Madic, F. Doudin, and C. Martin. 2006. Biotic and abiotic factors influencing in vitro growth of *Escherichia coli* O157:H7 in ruminant digestive contents. Appl. Environ. Microbiol. 72:4136-4142.

Cooper, R., T.J. Klopfenstein, R. Stock, C. Parrott, and D. Herold. 1997. Effect of rumensin and feed intake variation on ruminal pH. Neb. Beef Report. University of Nebraska-Lincoln.

Danscher, A.M., M.B. Thoefner, P.M.H. Heegaard, C.T. Ekstrøm, and S. Jacobsen. 2010. Acute phase protein response during acute ruminal acidosis in cattle. Livestock Sci. In press.

Gozho G.N., J.C. Plaizier, D.O. Krause, A.D. Kennedy, and K.M. Wittenberg. 2005. Subacute ruminal acidosis induces ruminal lipopolysaccharide endotoxin release and triggers an inflammatory response. J. Dairy Sci. 88:1399-403.

Keyser, S.A., J.P. McMeniman, D.R. Smith, J.C. MacDonald, and M.L. Galyean. 2007. Effects of *Saccharomyces cerevisiae* subspecies *boulardii* CNCM I-1079 on feed intake by healthy beef cattle treated with florfenicol and on health and performance of newly received beef heifers. J. Anim. Sci. 85:1264-1273.

Kelzer, J.M., C.R. Dahlen, G.I. Crawford, and A. DiCostanzo. 2010. Assessment of the Value of Spayed Heifers for Marketing. Proc. Minnesota Beef Cow/Calf Days. 31-39.

Khafipour, E., D.O. Krause, and J.C. Plaizier. 2009. A grain-based subacute ruminal acidosis challenge causes translocation of lipopolysaccharide and triggers inflammation. J. Dairy Sci. 92:1060-70.

Lawrence, J.D. and M.A. Ibarburu. 2006. Economic Analysis of Pharmaceutical Technologies in Modern Beef Production in a Bioeconomy Era. http://www2.econ.iastate.edu/faculty/lawrence/documents/GET7401-LawrencePaper.pdf Accessed July 20, 2010.

Newbold, C.J., R.J. Walllace, X.B. Chen, and F.M. McIntosh. 1995. Different Strains of *Saccaromyces cerevisae* differ in their effects on ruminal bacterial numbers in vitro and in sheep. J. Anim. Sci. 73:1811-1818.

Parrot, T.D., T.G. Rehberger, and F.N. Owens. 2001. Selecting Propionibacterium strains capable of utilizing lactic acid from *in vitro* models. http://forhealthycows.com/documents/a2eb0aa5-7aa1-4504-9640-96bed410106cn.pdf Accessed July 29, 2010.

Sharon, N. and H. Liz. 1993. Carbohydrates in cell recognition. Sci. Am. 268:82-9.

Tabe, E.S., J. Oloya, D.K. Doetkott, M.L. Bauer, P.S. Gibbs, and M.L. Khaitsa. 2008. Comparative effect of direct-fed microbials on fecal shedding of *Escherichia coli* O157:H7 and *Salmonella* in naturally infected feedlot cattle. J. Food Prot. 71:539-544.

USDA. 2006. Meat and Poultry Labeling Terms. http://www.fsis.usda.gov/factsheets/Meat_&_Poultry_Labeling_Terms/index.asp Accessed July 14, 2010.

Wohlt, J.E., A.D. Finkelstein, and C.H. Chung. 1991. Yeast culture to improve intake, nutrient digestibility, and performance by dairy cattle during early lactation. J. Dairy Sci. 74:1395-400.