



Research Update

► Summaries of current beef cattle research

Winter research highlights: Part 1

The following research highlights are presented by Harlan Ritchie, Steven Rust and Daniel Buskirk, beef cattle specialists at Michigan State University (MSU), East Lansing. The reviews summarize studies and trends reported at scientific meetings or in scientific and industry publications, which are cited at the end of each item. Part 1 includes items focused on this issue's theme of "feeding and feedstuffs."

Feeding & Feedstuffs

COW-CALF

Effects of nutritional restriction during gestation

It has been hypothesized that nutritional restriction during gestation will cause fetal adaptations that can subsequently affect the animal's performance. In a University of Wyoming study, a total of 116 pregnant mature Angus × Gelbvieh cows were assigned to two different treatments:

1. Control cows received 100% of National Research Council (NRC) nutrient requirements for pregnant beef cows throughout gestation.
2. Nutrient-restricted cows were limited to 68.1% of net energy for maintenance (NE_m) and 50% of vitamin and mineral requirements from Day 30 to Day 120 of gestation, then at Day 120 were adjusted to a

high-energy supplement to achieve a similar body condition score (BCS) as controls at Day 250 of gestation.

Calves were weaned at 155 days of age, and steer calves were placed on a finishing diet for 168 days prior to harvest.

There were no differences in initial weight, total feedlot gain or feed consumption. Steers from nutrient-restricted dams had higher average daily gains (ADG), gain:feed ratio, and tended to have heavier final weights. Carcass fat thickness (FT) tended to be less for steers from nutrient-restricted dams.

There were no significant differences in ribeye area (REA); percentage kidney, pelvic and heart fat (KPH); hot carcass weight (HCW); yield grade (YG); marbling score; Warner-Bratzler shear force (WBSF) score; or dressing percentage.

The results of this study would suggest that nutrient restriction during early and mid-gestation does not have adverse effects on subsequent calf performance or carcass characteristics.

(Underwood *et al.* 2006. Univ. of Wyoming Animal Science Report)

Effects of three hay feeding methods on cow performance, wintering cost

The primary objective of this three-year North Dakota State University (NDSU) project was to compare the effects of three

different methods of feeding hay on cow wintering cost. The three methods were:

1. round bales fed by rolling bales on the ground;
2. round bales shredded with a power-takeoff-driven bale processor and fed on the ground; and
3. round bales fed by placing the bale in a tapered-cone round-bale feeder.

Cows were in their third trimester of pregnancy and were on feed for an average of 59 days. Alfalfa-grass hay was fed during the first two years. Oat hay was fed in the third year.

Compared with Treatments 1 and 2, feeding bales in a tapered-cone feeder significantly increased cow weight gain; resulted in greater positive rib fat gain; reduced hay consumption an average of 10.2%; and reduced hay waste in the two years of the study when alfalfa-grass hay was fed, but not when oat hay was fed.

Average costs per cow for the three-year period for a 100-cow herd were \$109.00, \$127.00 and \$100.30 for treatments 1, 2 and 3, respectively.

Under the conditions of this study, feeding round bales in a tapered-cone feeder clearly had an advantage over the other two methods.

(Landblom *et al.* 2006. NDSU Beef Cattle and Range Research Report)

STOCKER/FEEDLOT

Feed conversion for soft- vs. hard-kernel corn

A trial by University of Nebraska researchers (Erickson *et al.*) compared seven different corn varieties fed as both high-moisture and dry-shelled corn. When the

ADG	average daily gains
BCS	body condition score
DMI	dry-matter intake
DOF	days on feed
FT	fat thickness
HCW	hot carcass weight
KPH	percentage kidney, pelvic and heart fat
NDSU	North Dakota State University
NE_m	net energy for maintenance
NRC	National Research Council
QG	quality grade
REA	ribeye area
WBSF	Warner-Bratzler shear force
YG	yield grade

Table 1: Effects of sickness on feedlot performance, profit

Item	Treatment Group		
	Healthy	One	Two
Days on feed	192 ^a	197 ^b	209 ^b
Avg. daily gain, lb.	1.45 ^a	1.39 ^b	1.26 ^b
Cost of gain, \$/lb.	\$1.26 ^a	\$1.43 ^b	\$1.76 ^c
Carcass value, \$/lb.	\$2.51 ^a	\$2.39 ^b	\$2.18 ^b
Net income, \$/head	\$14.01 ^a	-\$69.63 ^b	-\$253.70 ^c

^{a,b,c} Values in rows having different superscripts are significantly different ($P < 0.01$).

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corn was fed as dry-rolled corn, the researchers observed an 8.4% improvement in feed conversion from a variety with softer kernels. However, there was little difference among soft- or hard-kernel varieties for ADG or HCW.

Researchers also found smaller differences in feed conversion when soft and hard kernels were fed as high-moisture corn. Their belief is that kernel hardness is not as large an issue when it is processed as high-moisture corn. The Nebraska scientists are following up their trial with a larger-scale study with six varieties fed to 72 pens of cattle as dry-rolled or high-moisture corn.

(H.C. Singleton, Feedlot magazine, Vol. XIV, No. 4)

Sickness affects feedlot performance, profitability

A total of 813 records from steers enrolled in the New Mexico Ranch to Rail program were used to determine the effects of feedlot morbidity on performance, carcass value and profitability. Steers were classified according to the number of medical treatments administered during the finishing period:

- ▶ zero treatments = healthy
- ▶ one treatment = one
- ▶ two or more treatments = two

Steers were assigned to marketing groups based on an ultrasound predicted optimum marketing date. Medical treatment was required by 22% of the steers.

As shown in Table 1, medical treatment had significant negative effects on performance, cost of gain, carcass value and net income. Steers requiring two treatments were significantly higher in cost of gain and significantly lower in net income than those requiring one treatment.

(Waggoner et al. 2006. J. Anim. Sci. 89 [Suppl. 1]: Abstract M15)

Effects of direct-fed microbial products on yearling steer performance

There are a number of direct-fed microbial products available for use in feedlot diets. In this West Texas A&M University study, 200 crossbred yearling steers (795 lb.) were allotted to either one of two different dietary treatments:

1. diet top-dressed with tap water only (Control); or
2. diet top-dressed with Micro-Cell LA for 28 days followed by Micro-Cell PB from Day 29 to harvest at Day 140 (LA/PB).

Micro-Cell LA contains *Lactobacillus acidophilus*, while Micro-Cell PB contains *Propionibacterium freudenreichii*.

There were no differences between treatments in performance traits during the first 28 days. Overall performance from Day 1 to Day 140 was not affected by treatment. Carcasses from Control steers had slightly greater external FT than LA/PB steers [0.51 inches (in.) vs. 0.47 in.]. However, there were no differences in other YG or quality grade (QG) attributes.

(Brown et al. 2006. Beef Cattle Research in Texas. The Texas A&M Univ. System)

Ractopamine effect less-pronounced in calf-feds

A total of 2,060 British × Continental steer calves (556 lb.) were used by Kansas State University researchers to evaluate the effects of ractopamine (Optaflexx®) and days on feed (DOF) on feedlot performance and carcass traits. Half the steers received ractopamine for the final 28 DOF at the rate of 200 milligrams (mg) per head daily. The

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other half received no ractopamine and served as controls. Within each treatment, steers were fed for either 181, 202 or 223 days.

Overall, feeding ractopamine increased ADG 2.7% and final weight 15.0 lb. compared to controls. Feeding ractopamine significantly improved feed efficiency (gain:feed ratio) in steers fed 202 days, but had no effect on those fed either 181 or 223 days. Ractopamine also improved HCW 10.1 lb., increased percent of YG 1 carcasses by 6 percentage units, and decreased percent grading Choice by 8 percentage units. There were no significant differences in other carcass measurements.

Additional DOF resulted in linear increases in dry-matter intake (DMI) and final weight, and linear decreases in ADG and gain:feed. As would be expected, increasing DOF resulted in linear increases in dressing percentage, HCW, FT, percent grading Choice or Prime and numerical YG.

The author noted that feeding ractopamine in this study had a less pronounced influence on growth with calves than has been reported elsewhere using yearlings.

(Reinhardt et al. 2006. J. Anim. Sci. 89 [Suppl. 1]: Abstract 539)

Effects of beta-agonists on steer performance, carcass traits

In a collaborative study, scientists at the Agricultural University, Baja California, Mexico, and the University of California, USA, allotted 54 steers (935 lb.) to three dietary treatments to determine the effects of two different beta-agonists on

performance, carcass characteristics and meat quality:

- ▶ controls (no supplement);
- ▶ *Zilpaterol hydrochloride* (60 mg per steer per day); and
- ▶ *Ractopamine hydrochloride* (300 mg per steer per day).

The beta-agonists were fed during the final 33 days of the finishing period.

Zilpaterol and ractopamine significantly increased ($P<0.01$) ADG by 26% and 24%, respectively, compared to control steers.

Feed efficiency was significantly improved ($P<0.01$) by both zilpaterol and ractopamine. The same was true for dressing percent and carcass weight.

REA was significantly increased by zilpaterol, but that of ractopamine was similar to controls.

Steaks from zilpaterol- and ractopamine-supplemented steers were less tender than those from control steers, as measured by WBSE.

The authors concluded that, in general, feedlot performance was greatly enhanced by beta-agonists, while meat tenderness from supplemented steers was classified as intermediate.

(Avendano-Reyes et al. 2006. J. Anim. Sci. 84:3259)

Effect of corn price on feeder-cattle price

Corn prices increased dramatically this past fall as a result of increased demand for corn for ethanol production, as well as for livestock feed. Cattle-Fax® analysts reported that, historically, a 50¢-per-bushel (bu.) increase in corn price has the effect of lowering 750-lb. feeder-cattle prices by nearly \$7 per hundredweight (cwt.) (\$52 per head), assuming a steady fed-cattle market. The following table shows the relationship of corn and fed-cattle prices on breakeven purchase price for a 750-lb. feeder steer.

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Table 2: Effects of corn price on feeder-cattle price

Fed price	Corn price, \$ per bushel				
	2.50	3.00	3.50	4.00	4.50
\$80.00	98.28	91.70	85.12	78.54	71.96
\$82.00	101.74	95.16	88.58	82.00	75.42
\$84.00	105.20	98.62	92.04	85.46	78.88
\$86.00	108.66	102.08	95.50	88.92	82.34
\$88.00	112.12	105.54	98.96	92.38	85.80
\$90.00	115.58	109.00	102.42	95.84	89.26
\$92.00	119.04	112.46	105.88	99.30	92.72

Assumptions: 3.4-lb. ADG; 9.75% interest; 1% death loss.

Feeding & Feedstuffs

Effects of ractopamine supplementation on steer behavior

Previous research with swine has shown that supplementation of the diet with ractopamine may adversely affect mobility, behavior and susceptibility to stress during handling and transport. Swine fed a diet supplemented with ractopamine for four weeks were more active, had higher heart rates and required more time and physical contact to be moved from their pens to a scale for weighing.

In a Colorado State University study, equal numbers of British, Continental crosses and Brahman crossbred calf-fed steers were assigned to either one of two treatments:

- ▶ controls, no ractopamine; or
- ▶ supplemented with 200 mg per steer per day of ractopamine during the last 28 days of the finishing period.

Subjective evaluation scores were recorded for entry force required, entry speed, behavior in the chute and exit speed.

Ractopamine supplementation had no effect on entry force score, chute behavior score or exit speed score; however, there was a tendency for ractopamine-supplemented steers to enter the chute more rapidly than control steers.

There were significant differences among biological types. Continental crosses required greater ($P < 0.05$) force to enter the chute than did Brahman crosses or British steers. Continental and Brahman crosses left the processing chute with the greatest speed, while British steers exited most slowly. Biological type did not affect entry speed or behavior during restraint in the chute.

The authors concluded that while there were differences among biological types, ractopamine supplementation had no adverse effects on cattle behavior.

(*Baszczak et al. 2006. J. Anim. Sci. 84:3410*)

Guidelines for supplementing finishing diets with fat

The use of fats as a fuel stock for large industrial boilers and furnaces has grown dramatically in recent years. Feed fats are also expected to become a feedstock for the renewable fuel industry. These

nontraditional uses for fats are projected to continue to grow in importance, and divert more and more product away from use in cattle feeding.

Ruminant nutritionist Marc Roth recently provided guidelines for the use of fat in finishing diets, using the as-fed price ratio of fat-to-steam-flaked corn:

- ▶ When the ratio is 2.5-to-1 or less, it is reasonable to use high levels (3%-4% as-fed) of supplemental fat.
- ▶ As the ratio moves above 3-to-1, the inclusion rate should be reduced (probably 2% or less as-fed)
- ▶ As the ratio moves higher than 3.5-to-1, the economics of fat supplementation become very questionable.

(*Feedstuffs magazine*)

CARCASS/MEAT SCIENCE

Field peas in finishing diets improved beef tenderness

A total of 118 heifers (926 lb.) were used in an NDSU study to determine the effects of increasing levels of field peas on feedlot performance, carcass quality and sensory characteristics of steaks. Treatments were 0%, 10%, 20% and 30% dry-rolled field peas replacing corn and canola meal in a corn-based finishing diet. Heifers were fed for 74 days prior to harvest.

There were no significant differences among treatments for DMI, ADG, feed conversion, QG or YG. Field pea inclusion resulted in improved tenderness as measured by lower WBSF values (9.48 lb., 8.00 lb., 8.11 lb. and 8.18 lb. for 0%, 10%, 20% and 30% peas, respectively). Sensory panel evaluations indicated a tendency for greater juiciness and no differences in flavor or off flavor.

The authors concluded that the improved tenderness observed in the study has implications for improving beef acceptability and may provide consumers with a more consistent, tender beef product (see "Affordable Feed, Tender Beef," page 132).

(*Maddock et al. 2006. J. Anim. Sci. 89 [Suppl. 1]: Abstract M91*)

Whole linseed increased omega-3 fatty acid content

Omega-3 fatty acids are known to have beneficial effects on cardiovascular health, and a lower ratio of omega-6 to omega-3 fatty acids in the diet is considered to be heart-healthy.

In a collaborative study, four research institutes in Spain assigned a total of 54 young Holstein bulls (664 lb.) to six different

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USDA Researchers Evaluate Prion-Free Cattle

The U.S. Department of Agriculture (USDA) Agricultural Research Service (ARS) announced Dec. 31, 2006, that initial results of a research project involving prion-free cattle are available online at www.nature.com/nbt. ARS scientists evaluated cattle that have been genetically modified so they do not produce prions, and determined that there were no observable adverse effects on the animals' health.

"These cattle can help in the exploration and improved understanding of how prions function and cause disease, especially with relation to bovine spongiform encephalopathy, or BSE," said Edward Knipping, ARS administrator. "In particular, cattle lacking the gene that produces prions can help scientists test the resistance to prion propagation, not only in the laboratory, but in live animals as well."

Prions are proteins that are naturally produced in animals. An abnormal form of prion is believed to cause devastating illnesses called transmissible spongiform encephalopathies (TSEs), such as BSE.

ARS studied eight Holstein males that were developed by Hematech Inc., a pharmaceutical research company based in Sioux Falls, S.D. The evaluation of the prion-free cattle was led by veterinary medical officer Juergen Richt of the ARS National Animal Disease Center (NADC) in Ames, Iowa. The evaluation revealed no apparent developmental abnormalities in the prion-free cattle.

"The cattle were monitored for growth and general health status from birth up to 19 months of age," Richt explained. "Mean birth and daily gain were both within the normal range for Holsteins. General physical examinations, done at monthly intervals by licensed veterinarians, revealed no unusual health problems."

ARS, with assistance from researchers at Hematech and the University of Texas, evaluated the cattle using careful observation, postmortem examination of two of the animals, and a technology that amplifies abnormal proteins to make them easier to detect. Further testing will take at least three years to complete.

The evaluation was reported in December 2006 on the online version of the scientific journal *Nature Biotechnology*.

— by Sean Adams

Editor's Note: Sean Adams is current information branch chief with ARS, which supplied this article.

treatments that involved three dietary fat levels (5%, 8% and 11%) and two fat sources (whole canola seed and whole linseed) with the objective of evaluating the possibility of increasing the omega-3 fatty acid content of beef. Bulls were fed a corn-based diet and harvested after 105 days on feed. After harvest, a sample of loin muscle was analyzed for intramuscular fat content and fatty acid profile.

Dietary fat source did not influence overall animal performance, rumen fermentation or carcass quality.

In bulls fed linseed, the percentage of omega-3 fatty acids in loin muscle increased linearly with fat level; whereas, in bulls fed canola seed it remained constant. The ratio of omega-6-to-omega-3 fatty acids was significantly lower ($P<0.01$) in the loin muscle of bulls fed linseed than in those fed canola seed.

The authors concluded that the content of omega-3 fatty acids in beef from young cattle fed concentrate-based diets can be enhanced by supplementation with whole linseed, and the ratio of omega-6-to-omega-3 can be reduced without notable effects on performance or carcass quality.

(Mach et al. 2006. J. Anim. Sci. 84:3039)

Implanting steers with zeranol improved fatty acid composition of beef fat

The objective of this University of Arizona trial was to determine the effects of implanting steers with 36 mg of zeranol (Ralgro™) on fatty acid composition of subcutaneous and intramuscular (marbling) fat. Forty steers were allotted to two treatments: controls, having no implants; and steers implanted with zeranol. Steers were harvested when they reached 0.4 in. subcutaneous fat thickness. Both subcutaneous and intramuscular fat were analyzed for concentration of polyunsaturated fatty acids, including omega-3 and omega-6 fatty acids, as well as saturated fatty acids.

Implanting had no effect on either QG or YG. Concentration of polyunsaturated fatty acids, including omega-3 and omega-6 fatty acids, was significantly ($P<0.05$) greater in subcutaneous fat of implanted vs. control steers. Concentration of saturated fatty acids was significantly ($P<0.05$) less in the subcutaneous fat of implanted steers than in subcutaneous fat of control steers. However, the concentration of monounsaturated fatty acids was greater ($P<0.05$) in the subcutaneous fat of control steers than in that of implanted steers.

In the intramuscular fat, implanted steers had greater ($P<0.05$) concentrations of polyunsaturated fatty acids, including omega-3 and omega-6 fatty acids, and one monounsaturated fatty acid. Concentration of saturated fatty acids was less ($P<0.05$) in the intramuscular fat of implanted steers than in control steers. Furthermore, implanting with zeranol resulted in an increase in the unsaturated-to-saturated fatty acid ratio and the omega-3-to-omega-6 ratio.

All of the changes in fatty acid composition noted above are favorable to human health, and the author concluded that it appears that fatty acid profiles of beef fat can be improved from a human health perspective by implanting with zeranol.

(Ibrahim et al. 2006. Prof. Anim. Sci. 22:301)

RETAIL

Organic meat sales will see strong growth in next five years

Mintel International Group, a research firm, has estimated that the organic meat market will increase by 71% during the next five years. According to their study, the sales of all organic foods, including meat and poultry, grew by 37% in the last two years in traditional channels, while sales were up by 29% at natural retailers. During the same two-year period, the organic meat sector grew by 140%, which was facilitated by the increased emphasis on organic meats at traditional retailers.

Plans by Wal-Mart to offer organic products priced only 10% higher than traditional processed products may also help boost organic growth in the future. According to the Mintel study, 24% of consumers who purchase organic products do so at Wal-Mart.

(Meatingplace.com)

Strong beef sales in heat-and-eat section

Busy shoppers are continually looking for food items that require minimal preparation. AC Nielsen research revealed that in 2005, dollar sales of refrigerated meat entrées increased by 10%, compared to a 1.25% growth of total meat dollar sales.

Beef is well-represented in the heat-and-eat section of the supermarket, although some items sell better than others. Following are the top 10 refrigerated beef items based on AC Nielsen sales data:

- ▶ pot roast
- ▶ beef tips with gravy

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- ▶ shredded beef
- ▶ taco-seasoned ground beef with sauce
- ▶ seasoned beef patties
- ▶ seasoned steak strips
- ▶ shredded barbecue beef brisket
- ▶ beef backribs with barbecue sauce
- ▶ beef steak with gravy
- ▶ seasoned beef meatloaf

(Meatingplace magazine)

CURRENT TRENDS

U.S. exports only 3% of its total beef production

Of the seven leading beef exporting nations, the United States ranks a distant seventh. As shown in Table 3, only 3% of U.S. beef production is exported. This compares with 13% in 2003. The U.S. is the only country among the seven that produces less than it consumes. Consequently, the export-oriented attitudes of the six “overproducers” are driving stronger competition internationally. This raises the question, “Is the U.S. losing out competitively in the international marketplace?”

(Cattle-Fax Update)

Table 3: Percentage of beef production exported¹

Country	Percent
1. New Zealand	85%
2. Uruguay	72%
3. Australia	65%
4. Canada	38%
5. Brazil	20%
6. Argentina	16%
7. United States	3%

¹USDA/FAS, 2006.

U.S. farmland values

U.S. farm real estate values, including all agricultural land and buildings, averaged \$1,900 per acre on Jan. 1, 2006, up from \$1,650 in 2005. The \$250-per-acre increase was the second-largest dollar increase in one year on record. The record was 2005, when farmland values increased \$290 per acre above the 2004 value.

The overall increase was driven by cropland and pastureland prices, which rose 13.3% and 22.0%, respectively. Cropland values averaged \$2,390 per acre and pastureland values averaged \$1,000 per acre, compared with \$2,110 and \$820, respectively, a year earlier.

(Kansas Agricultural Statistics)

FUTURE TRENDS

Demand for biofuels will push corn and soybean prices higher

With 2005's output of ethanol projected to double by 2008, the demand for corn for ethanol production will continue to soar. Kiplinger analysts predict a U.S. record corn price in 2007 of \$3.50 per bu. for the annual average. That is about 25¢ over the record annual average set in 1995-1996. At least one-fourth of the projected 2008 U.S. crop of 11 billion bu. will go toward producing ethanol vs. only 6% in 2000. The high prices will encourage farmers to plant more acres and continue to enhance yields, raising 5 billion bu. more corn a year by 2010.

The outlook for soybeans is similar to that of corn. The dramatic increase in demand for biofuel and long-term supply fears pushed soybeans to around \$6.50 per bu. after the 2006 record harvest. This is extraordinary because big harvests usually result in depressed prices.

Future profitability is a strong possibility as more biodiesel plants are built throughout the U.S., processing soybeans as well as canola. By late 2007, more than 100 biodiesel plants will require 8% of U.S. oilseed crops. More soybeans will be planted to meet biofuel needs while still meeting traditional demands for food uses and livestock feed.

Biofuels will be profitable as long as fossil fuels remain high-priced. If oil prices stay between \$50 and \$60 per barrel in 2007, ethanol producers can pay as much as \$5 for a bushel of corn and still make money, thanks to tax breaks. That's in spite of rising net costs for corn — 80¢-90¢ per gallon (gal.) of fuel, after byproducts.

And with ethanol at \$2 per gal., plants have a cushion for variable and capital costs. As an example, if ethanol producers are paying \$2.60 per bu. for corn, they can sell \$6 worth of ethanol from that bushel. Future technological advances will also help. New crop traits, improved processing enzymes, and other breakthroughs will enhance profits.

Global use of biofuel will likely increase by 7%-9% each year through 2030, according to the International Energy Agency. This means that biofuel will compete for land with feed and food crops. One percent of the world's available land is now devoted to biofuel crops. This is projected to rise as high as 4% by 2030. With the world population growing 1.1% a year, biofuel will squeeze feed and food supplies, enticing greater agriculture output.

(Kiplinger Agriculture Letter)

