Lipids and Reproduction: A Reality Check

Conflicting results frustrate determination of the exact role dietary lipids play in beef cattle reproduction.

Story by
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While the jury is still out on how extensively lipids influence the reproductive process in cattle, experts stress that a well-balanced program for protein and energy is essential to achieving an animal's reproductive potential.

For scientists like Rick Funston, beef researcher at the University of Nebraska's West Central Research and Extension Center, determining the exact role dietary lipids play in beef cattle reproduction has proven to be, more than once, an exercise in frustration.

"The complexity of the reproductive system and makeup of fat supplements are often confounded by management conditions and forage quality both in research and in commercial feeding situations," he says. "This confounding has contributed to inconsistencies in research findings."

In a report on the subject presented at the 2007 American Dairy Science Association/American Society of Animal Science (ADSA/ASAS) conference, Funston points out that the limited successes in developing a comprehensive understanding of all the roles lipids play in reproduction isn't for want of trying.

During the past two decades he and other researchers in the U.S. and abroad have devoted a great deal of energy to exploring how, what and when fats influence the reproductive process in beef cattle. While major questions still remain unanswered, Funston is the first to admit that our knowledge in some specific areas has improved dramatically.

He points out that although fat supplementation as an energy density enhancer to maintain body condition and overall reproductive function in cows remains the primary use of lipids in today's beef industry, supplementing specific lipids can play a variety of other roles. These depend on what facet of reproduction they are being applied to and the timing of the supplementation.

"Those looking for a cure-all in

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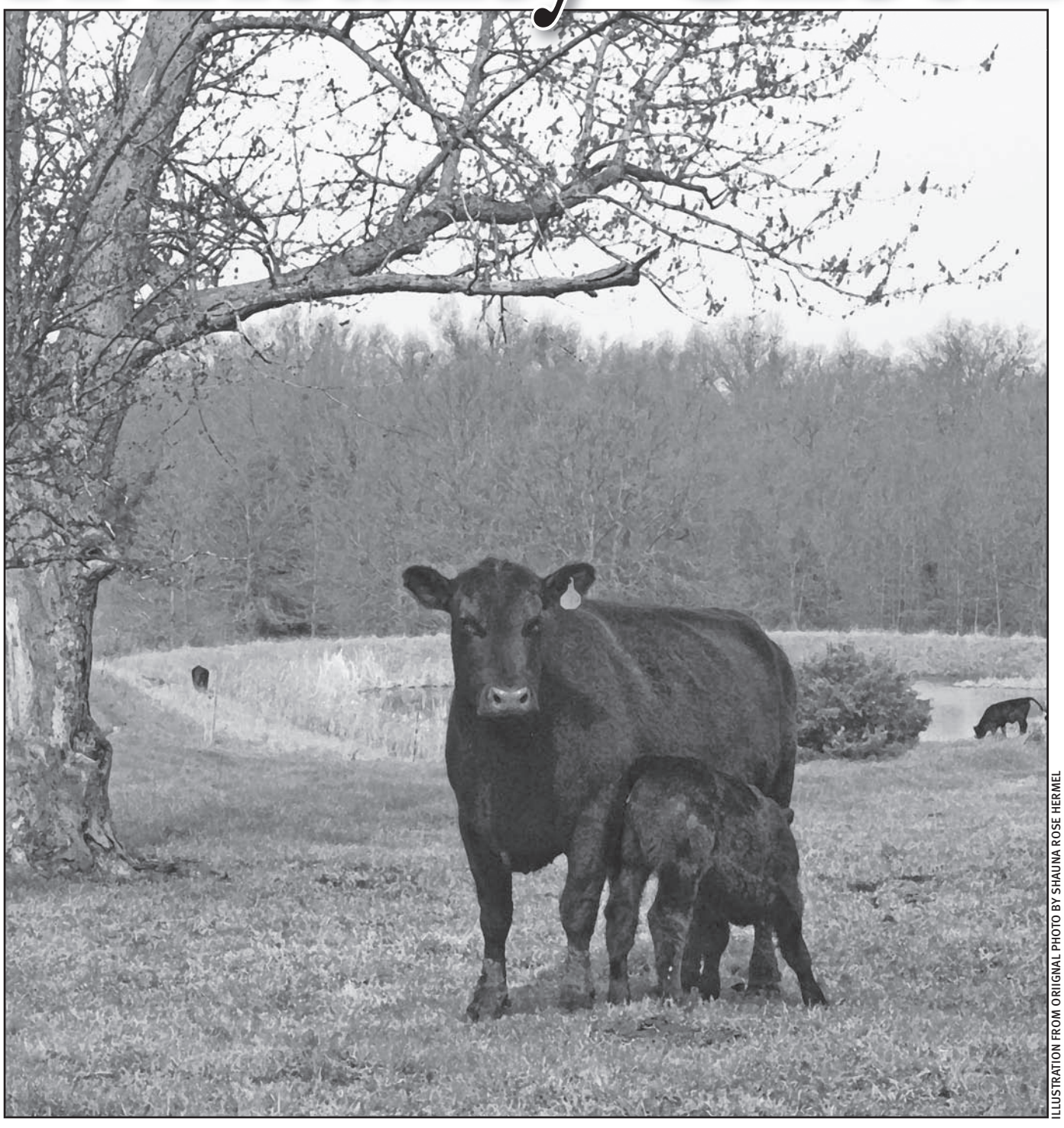

ILLUSTRATION FROM ORIIGNAL PHOTO BY SHAUNA ROSE HERMEL

Table 1: Relationship of body condition score (BCS) to beef cow performance and income

BCS	Pregnancy rate, %	Calving interval, days	Calf ADG, lb.	Calf weaning wt., lb,	Calf price, $ per cwt.	$ per cow exposed[a]
3	43	414	1.60	374	96	154
4	61	381	1.75	460	86	241
5	86	364	1.85	514	81	358
6	93	364	1.85	514	81	387

[a]Income per calf × pregnancy rate.

Source: Rick Funston, Montana State University.

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lipids will be disappointed," Funston says. "Right now good management and feeding a balanced diet will probably go further to dealing with reproductive issues than adding lipids to cure a specific problem."

He adds that a big part of that good management package is understanding the role lipids play in the reproductive process and applying the knowledge, already validated by science, to the practice of raising beef.

Not all fats are equal

Doug Landblom, North Dakota State University (NDSU) beef researcher, agrees with Funston, saying one of the most important roles lipids play is serving as a primary source of nutrition-based energy.

When looking at the various supplemental fats available, Landblom sees little difference in their effectiveness when used to maintain or improve the body condition of cows.

"As a pure energy source, I don't see that much difference in the performance of the saturated fats versus the unsaturated," he says. "But, from a reproductive standpoint, there does seem to be a tendency toward a better response — if there is going to be one — with the unsaturated fats."

Landblom's research into supplementing both saturated and unsaturated fats to cows before calving confirms this.

"Unlike the project in which we supplemented unsaturated fat and saw a definite difference in rebreeding performance between the cows that received the fat before calving and the control group that didn't, the study in which we used saturated fats didn't get much of a response at all," he says, noting that other researchers conducting similar studies have observed the difference between the two types of lipids.

Funston concurs that oils derived from plants appear to have the greatest effect on reproduction, adding that the most common sources include sunflower, safflower, cottonseed, rice hulls and soybeans.

"In the research reviewed, the more consistent effects on reproduction have generally been with the unsaturated fatty acids versus the saturated fatty acids," Funston says.

He reports that saturated fats often derived from animals, such as tallow and calcium salts of fatty acids, escape rumen biohydrogenation to a greater extent than plant fats and are more likely to be incorporated into adipose tissue and milk. The effects of those fats on reproductive function appear to be more variable. An exception is the polyunsaturated fatty acids in fishmeal. While they also bypass the rumen, they have been documented to affect the reproductive processes.

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>
> ***— Doug Landblom***

Funston points out that this isn't the only exception to what some regard as the general role various fats play in reproduction.

"Recent research shows feeding lipids high in linoleic acid has been demonstrated to have a negative effect on reproduction postpartum," he says, citing, as an example, a study conducted in 2003 finding that supplementing beef cows postpartum with high-linoleate safflower seed increased prostaglandin (PGF)-metabolite from 25 to 80 days postpartum and tended to decrease first-service conception rates.

He notes there is a distinct difference between viewing fats as a general source of energy and studying the effects of lipids on specific aspects of the reproductive process. "In looking at the role of lipids, what has the impact on reproduction are the fatty acids within the fat source, and they vary greatly," Funston says.

Effect of lipids

In his report, Funston points out that the effects of supplemental lipids on various aspects of the reproductive process have been mixed and in most cases inconclusive. "There has been a great deal of difficulty in duplicating research," he says. "In most studies to date there has been a lack of consistent effect on pregnancy rates."

Like Landblom, Funston sees the single exception to this as being the feeding of unsaturated fats prior to calving. He notes a 1997 study showed that supplementing the diet of late-gestation heifers (Day 230 until calving) with safflower seeds at 0.68 kilograms (kg) per day (approximately 4.7% fat in the diet) increased subsequent pregnancy rate by 19% compared to control diets with similar energy and protein content.

In a study four years later, first-calf heifers supplemented with safflower seeds, soybeans or sunflower seeds (4.7%, 3.8% and 5.1% fat in the diet, respectively) for the last 65 days before calving increased subsequent pregnancy rates (94%, 90% and 91%, respectively) compared to controls (79%) receiving diets with equivalent energy (2.4% fat).

Funston notes that even in duplicated studies, hidden exceptions can sometimes emerge after the fact. In a third experiment, supplementing diets with sunflower seeds (6.5% fat in the diet) the last 68 days before calving did not improve subsequent pregnancy rate compared to control diet (2.2% fat).

After analyzing the data from the contradictory studies it was determined that forage availability and quality were the key factors responsible for the conflicting results. There was 71% more forage available to the animals in the last study, and the nutrient quality, when compared to the earlier study, was substantially higher in relation to protein and fat.

Based on the available evidence, researchers concluded that, with the elevated volume and quality of forage available to the cows in the last study, they were able to attain their near-maximal, plateaued nutritional-reproduction response. Funston points out in his report that the consumption of superior-quality forage at higher levels tended to mask any carryover effect resulting from supplemental fat fed in the gestation diet.

Word to the wise

As Funston has clearly stated, while specific reproductive processes have been found to be affected by particular fatty acids, that effect doesn't necessarily translate into enhanced pregnancy rates or any other reproductive improvement that can be taken to the bank.

"Several hormones that are important for reproduction have been found to be affected by lipid supplementation," he says. "In spite of this, there has been a lack of consistent effects on pregnancy rates."

Nor can it be determined conclusively that those improvements in reproduction reported in some studies are the result of added energy in the diet or a direct effect of specific fatty acids on the reproductive processes.

"Until these interrelationships are better understood, producers are advised to strive for low-cost and balanced rations," Funston says. "Only if a source

Table 2: Effect of pre- or postpartum dietary energy or protein on pregnancy rates in cows and heifers

Nutrient and time	Adequate	Inadequate
	Percent pregnant	
Energy level precalving[a]	73%	60%
Energy level postcalving[b]	92%	66%
Protein level precalving[c]	80%	55%
Protein level postcalving[d]	90%	69%

[a,b,c,d]Combined data from two, four, nine and 10 studies, respectively.

Source: Rick Funston, Montana State University.

Table 3: Effects of feed level during gestation on calving and subsequent reproduction[a]

Item	Gestation diet of dam: Low	High[b]
Calf birth weight, lb.	63	69
Dystocia, %	35	28
Calf survival, %		
At birth	93	91
Weaning	58	85
Scours, %		
Incidence	52	33
Mortality	19	0
Dam traits		
Estrus prior to breeding season, %	48	69
Pregnancy, %	65	75
Precalving pelvic area, cm^2	256	271

[a]Averages from seven studies.
[b]Diet level fed from up to 150 days precalving; low and high, animals lost or gained weight precalving, respectively.

Source: Rick Funston, Montana State University.

Table 4: Influence of postpartum diet on weight change, body condition score (BCS) change and postpartum interval (PPI)

Item	Diet: Low	Maintenance	Maint./High	High
Weight, lb.	835	822	826	821
BCS	4.27	4.26	4.18	4.10
PPI, days	134	120	115	114
PPI wt. change, lb.	12	40	70	77
PPI BCS change	-.32	.37	1.24	1.50

Source: Rick Funston, Montana State University.

Nutritional tips for optimizing reproductive efficiency

- A sound herd health program is essential for optimum reproductive efficiency.
- Make sure heifers are on a balanced ration the last trimester of pregnancy through the breeding season.
- Research shows if there is a reproductive benefit to supplementing fat it is probably prepartum, targeting those animals in most need, such as the young growing females that are carrying a calf for the first time.
- Heifers should be in optimum body condition (5-6) at calving and through the breeding season.

of supplemental fat can be added with little or no change in the ration cost would producers be advised to do so."

Instead Funston recommends a systems approach to reproductive management. This includes a sound herd health program with appropriate supplementation to support immune system function, proper overall nutrition and proactive measures to control diseases and disorders that could otherwise negatively affect calf production.

He also emphasizes the importance of making sure that each animal maintains the appropriate body condition score (BCS) throughout its reproductive life.

"Body condition is correlated with several reproductive events, such as postpartum interval, services per conception, calving interval, milk production, weaning weight, calving difficulty and calf survival, and can greatly affect net income on a cow-calf operation," Funston says, adding that this is particularly true for animals that are still developing. "At calving, it is the single most important factor controlling when a beef heifer will cycle after calving. Heifers should have an optimum body condition [score] of 5 to 6 at calving through breeding to assure optimal reproductive performance."

Funston points out that this involves feeding a balanced ration to heifers in the last trimester of pregnancy through the breeding season. He notes nutritional demands increase greatly in late gestation and even more in early lactation and that studies confirm that responding to those demands by supplementing oilseed sources prepartum to heifers increases conception rates and tends to increase calf weaning weights.

Conversely, research cited by Funston confirms that heifers fed diets deficient in energy or protein the last trimester not only experience more calving difficulty, but breed back later in the breeding season and have increased sickness, death and lower weaning weights in their calves.

"Reproduction has low priority among partitioning of nutrients, and, consequently, cows in thin body condition often don't rebreed," he says, adding that the last 50 to 60 days prior to calving has a profound effect on postpartum interval.