THE SEARCH FOR THE *Elusive* OPTIMUM COW

BY HARLAN RITCHIE

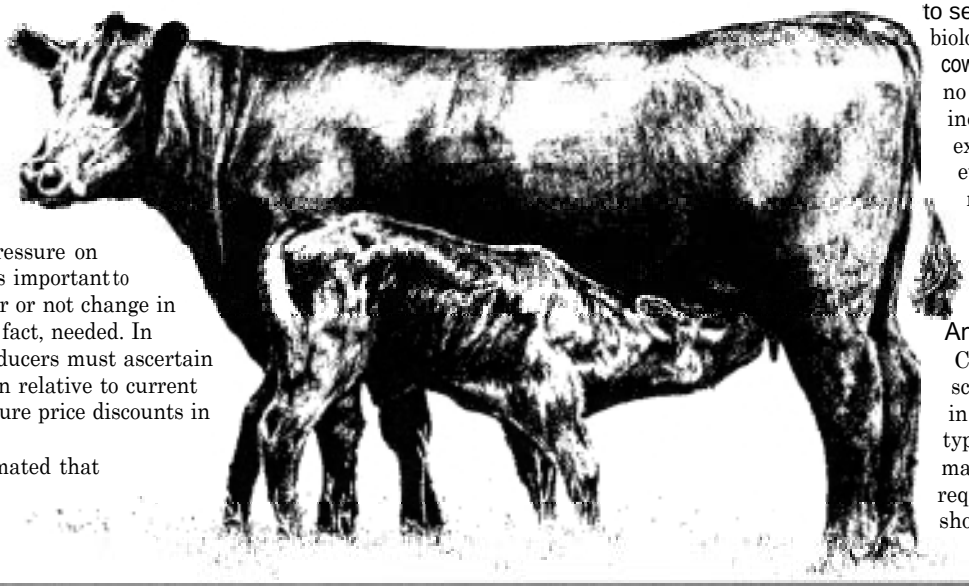
The optimum beef cow is indeed an elusive beast. I have searched for her for more than 20 years, and have come up empty handed. But I believe I'm getting close.

During this search, I've heard her defined in numerous ways – the high performance cow, the minimum-care cow, the low-maintenance cow, and the biologically efficient cow – to mention a few.

The latter definition served as the focal point of the Beef Cow Efficiency Forum held in 1984 at Colorado State University and Michigan State University. The purpose of this conference was to review research that had been conducted to date on beef production efficiency. The ultimate objective was to identify potential means for improving beef production efficiency, particularly in the cow-calf segment of the industry.

In recent years the potential emergence of value-based marketing and an increased emphasis on the end-product has added a new dimension to the search.

"The challenge to the beef industry is to retain marketshare by reducing fat and increasing palatability and consistency, while at the same time improving production efficency and sustaining profitability," says Michael Dikeman, animal scientist at Kansas State University.



Tom Field of Colorado State University adds a word of caution to cow-calf producers. He believes that before beef producers their selection pressure on carcass traits, it's important to establish whether or not change in their herds is, in fact, needed. In other words, producers must ascertain their own position relative to current and potential future price discounts in the marketplace.

It's been estimated that only 6 percent of the total life cycle dietary energy expanded in beef production is used for protein deposition in market progeny. Pork and broiler chicken production are much more efficient at 14 percent and 21 percent, respectively.

A high percentage of the total life cycle diet used in beef production, however, is composed of high-fiber forages which cannot be utilized by monogastric species such as swine, poultry and humans. Nonetheless, it remains clear that beef production is a relatively inefficient process from the standpoint of total energy expenditure. This begs the question, "Why is it inefficient?"

Maintenance

One explanation for the energetic inefficiency of beef production is the high cost of maintenance. Approximately 71 percent of the total dietary energy expenditure in beef production is used for maintenance and 70 percent of the maintenance energy is required for the cow herd. Therefore, a staggering 50 percent of total energy expended in producing beef is used for maintenance of the cow.

Research indicates the genetic variation for maintenance energy requirement of beef cows is moderate to high. This suggests opportunities to select for more biologically efficient cows. Unfortunately no simple and inexpensive method exists for evaluating the maintenance requirements of individual cattle.

U.S. Meat Animal Research Center (MARC) scientists reported in 1984 that breed types differ in their maintenance requirement, as shown in Table 1.

The heavier-milking breeds, Jersey and Simmental, exhibited greater maintenance needs during both lactation and dry periods. Texas researchers reported similar results in 1988.

Table 1. Estimates of metabolizable energy (ME) required for maintenance of four biological types of nonpregnant, nonlactating cows

Cow breed	Maintenance requirement (Kilocalories ME per kg metabolic body wt. per day)
Angus x Hereford	130
Charolais x British	129
Jersey x British	145
Simmental x British	160

Source: Ferrell & Jenkins 1984 *Journal of Animal Science* 58:234

The researchers attributed this to the high productivity cattle's increased mass of visceral organs, especially the gastrointestinal tract and liver, which have a high rate of energy expenditure. Furthermore, the increased lean tissue mass in heavier-muscled animals may result in higher energy expenditure because more energy is required to maintain a given weight of body protein than a comparable weight of body fat.

Following are characteristics of the high maintenance and low maintenance cow:

High Maintenance Cow	low Maintenance Cow
High milk production	Low milk production
High visceral organ weight	Low visceral organ weight
High body lean mass	Low body lean mass
Low body fat mass	High body fat mass
High output and high input	Low output and low input

All of this implies a need for balance based upon the production environment and the market requirements for a given region and/or a given farm or ranch.

Measures of Biological Efficiency

The measures of beef cow efficiency up to weaning time that have been commonly used in research studies include:

1. Pounds of calf weaned per cow exposed;
2. Pounds of calf weaned per cow exposed per pound of cow weight;
3. Pounds of calf weaned per cow exposed per unit of feed energy consumed.

In studies involving retained ownership up to slaughter time, measures of efficiency have included

1. Pounds of slaughter progeny weight per unit of feed energy consumed by cow and progeny;
2. Pounds carcass weight per unit of feed energy consumed by cow and progeny;
3. Pounds edible beef per unit of feed energy consumed by cow and progeny.

In some retained ownership trials, reproductive rate was included in the efficiency equation; in others it wasn't.

In summarizing the 1984 Beef Cow Efficiency Forum, the following conclusions were drawn:

- Measures of mature cow size (weight, height, etc.) are not correlated with biological efficiency.
- Acceptable market weight range should be a major consideration when decisions are made regarding breed size and mating systems.
- Large differences in reproductive rate have a profound impact on cow efficiency and tend to override all other factors, including calf weight and feed consumption.
- Under a liberal feed supply and/or relatively stress-free environment, there is a tendency for larger, heavier-milking biological types to be more efficient than moderate types.
- Under a restricted feed supply and/or stressful environment, biological types having moderate size and moderate milk tend to be better adapted and more efficient than larger, heavier-milking types.

The latter two conclusions were recently confirmed in an extensive five-year study by MARC scientists Thomas Jenkins and Calvin Ferrell. They compared biological efficiencies of nine pure breeds of mature cows fed year-round on one of four different levels of dry matter. The cows were mated to have purebred calves. Biological efficiency was expressed as grams (g) of calfweaned per kilogram (kg) of dry matter intake per cow exposed. (Metric conversion: 1 kg= 2.2 lb.)

Table 2 shows that if dry matter intake increased from 3,500 to 7,000 kg per cow per year, there was a dramatic change in breed efficiency.

For example, at 3,500 kg, Red Poll and Angus were the most efficient breeds, but at 7,000 kg, they ranked considerably lower. Conversely, Simmental, Charolais, Gelbvieh, Braunvieh and Limousin improved markedly when their intake went from 3,500 to 7,000 kg.

Table 2. Predicted biological efficiency at varying dry matter intakes for nine breeds of cattle

Cattle Breed	Dry matter intake, kg/cow/yr.	
	3,500	7,000
	g calf weaned/kg DM/cow exposed	
Angus	39	17
Braunvieh	33	42
Charolais	27	45
Gelbvieh	29	36
Hereford	30	13
Limousin	33	42
Pinzgauer	38	44
Red Poll	47	24
Simmental	26	42

Source: Jenkins & Ferrell 1994 *Journal of Animal Science* 72:2787

Since the 1984 Beef Cow Efficiency Forum, a number of research teams have included measures of economic efficiency in their experiment design.

Merlyn Nielsen and his colleagues at University of Nebraska conducted a classic study on economic efficiency of three biological types of cows that differed in milk production but were similar in body size. Low milk cows were Hereford x Angus crosses, medium cows were Red Poll x Angus crosses, and high cows were Milking Shorthorn x Angus crosses. All three groups were fed in a manner that allowed them to express their milk production potential.

Measure of economic efficiency was the value ratio of output per $100 of total input costs. If calves were sold at weaning time, the spread between milk groups was relatively narrow, but favored the low and medium groups over the high group.

If progeny were sold as finished cattle, rank of the groups remained the same, but the spread among them was greater than at weaning time. It should be noted that the "low" cows were actually relatively good milkers by industry standards. Average production of mature cows over a 205-day lactation was nearly 14 pounds per day. In general, a level of 12 pounds per day is adequate to raise a thrifty calf with an acceptable weaning weight.

Table 3. Economic efficiency of beef production from three milk groups

Cow milk group	205 day milk prod. lb.*	Sale time	
		Weaning	Slaughter
		$Output/$100 Input	
Low	2833	90.3	99.5
Medium	3599	89.2	96.5
High	4143	88.1	95.3

Source Van Oijen 1993 *Journal of Animal Science* 71: 44
* Cows 4 yrs and older used in study.

Table 4 demonstrates the effect of cow culling age on efficiency. The measure of economic efficiency was $ cost per 100 pounds of slaughter progeny weight. This study illustrates that longevity (stayability) has economic value. Cost of production declined as cows stayed in the herd for a greater number of years.

One breed association, Red Angus, is now including expected progeny differences (EPDs) for stayability in its cattle evaluation program and other associations are considering it.

Table 4. Effect of cow culling age on beef herd efficiency

Maximum cow culling age (yr.)	Measure of efficiency: Biological (lb. TDN/lb. slaughterwt.)	Measure of efficiency: Economic ($ cost/cwt. slaughterwt.)
[illegible]	10.09 9.78	74.83 72.12
11	9.55	69.39
13	9.30	68.03
15	9.10	67.57

Source Kress 1988 *Journal of Animal Science* 66 (Suppl I) 175

In summary

The optimum cow is really a moving target. She must vary with the production environment and the requirement of the marketplace.

'Maximum profitability is usually achieved before maximum productivity," says Robert Taylor, beef scientist at Colorado State University.

In the final analysis, each producer must weigh his or her own situation and fit the cow to that situation. You should also look to the future and be flexible enough to make subtle alterations as conditions change.

I pose the following questions and answers as food for thought:

- Is there an optimum cow? *Yes, for a given production and marketing environment.*
- Have we fully characterized those optimum cows? *No, but we're getting closer.*
- What is impeding our progress? *Antagonisms between reproduction, growth and carcass traits.*
- Is there a solution? *Perhaps. Development of selection indexes within a production/marketing environment is a possibility,*
- Is it do-able? *I'm not certain. I would hope so!*

Editor's note: *Harlan Ritchie, Extension beef specialist at Michigan State University, presented this research report at the 1995 Beef Improvement Federation (BIF) Conference in Sheridan,* Wyo. *For a copy of the complete report, contact the department of animal sciences, Anthony Hall, Michigan State University, East Lansing, MI 48824.*

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