From BIF:

Biological Efficiency of Production

by **Troy Smith**

It's a term they use often, but beef producers don't always agree on its definition. According to animal scientist David Notter, of Virginia Polytechnic Institute and State University, the term "efficiency" is overused considering the lack of industry-wide consensus on what it means. Notter blames the segmented nature of the beef industry for potentially conflicting definitions. It's not easy to reconcile the grazier's emphasis on cow efficiency, through use of grazed forages, with the feeder's notion of growth efficiency utilizing harvested concentrates.

The biological traits supporting efficient use of the two resources are markedly different, but both grazed forages and harvested concentrates make significant contributions to beef production. According to Notter, the potential substitution of one feed source for the other, with consideration to their relative costs, means economics also influence the definition of biological efficiency.

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Another economic factor is the U.S. beef marketing system, which rewards both fat (quality grade) and lean (yield grade) to create differential product pricing.

Consequently, Notter defines biological efficiency as *the capacity to convert physical inputs (feed) into marketable product (beef) under prevailing production conditions.* He cautions producers to consider the issues of genetic diversity, breeding structure and capacity for short-term adjustments. Producers will find it to their advantage to have the ability to rapidly adjust the characteristics of their cattle to changes in economic conditions.

"Hold on to your flexibility," Notter advises. "Breed for diversity."

Cow efficiency

The cow herd illustrates the near impossibility of separating biological and economic efficiency. Ample research suggests that cow size and milk production have optimum levels appropriate to each production environment, management system and marketing scheme.

Notter says milk production, in particular, is dictated almost exclusively on economic grounds involving relative costs of cow diets and finishing diets and patterns of retained ownership. On purely biological grounds, milk production beyond that required to maximize calf survival and health, and to set the stage for optimal postweaning growth, is not needed.

"Access to six to eight breed types representing various combinations of frame size, adult weight and milk production potential, and with access to within- and across-breed EPDs (expected progeny differences), seems appropriate to permit prompt (one-generation) adjustments in cow performance traits to meet temporary or unpredictable changes in economic conditions," Notter states.

The high proportion of total inputs expended for cow maintenance is a significant limitation to increased biological efficiency. According to Notter, spreading the cost of cow maintenance over larger offspring numbers seems like a viable strategy for improving biological efficiency of beef production, prompting research involving selection for increased twinning rates in cattle.

"What could be better than increasing output from the cow herd by perhaps 15%?" Notter asks. "Twinning offers a marvelous opportunity to increase biological efficiency — except for the mitigating economic factors. Producers are reluctant to deal with the increased dystocia, lowered calf survival and lowered conception at rebreeding that accompanies higher frequencies of twinning."

Growth efficiency

The biological traits influencing efficiency in the growing market animal differ considerably from those desired in the cow herd. Issues of appetite, lean growth potential, growth efficiency, and carcass fat level and distribution become primary. Most of these traits are largely independent of the traits that define cow efficiency.

The feedlot favors high feed intake and rapid growth, provided that appetite and lean growth potential are synchronized to prevent excessive fat deposition. Lower appetite is acceptable and may be preferable when lean-growth potential is more limited. Leanness is desirable, Notter affirms, but being lean by eating less and growing less is not efficient.

The discovery that two different mutant forms of the myostatin gene are responsible for muscular hyperplasia (double muscling) in the Piedmontese and Belgian Blue breeds prompted attempts to use muscular hyperplasia to increase muscularity and leanness.

According to Notter, there appears to be little effect on appetite, postweaning gain or feed conversion, but the efficiency of lean tissue gain is clearly improved by management of the myostatin gene. However, the negative effect is reduced marbling scores, which limits the advantages of improved lean gain efficiency in traditional markets relying on USDA quality grades. Other potential negative effects were increased birth weights and increased calving difficulty. Here too, biological efficiency is trumped by economic factors.

Biological efficiency of beef production, Notter says, is best viewed as a characteristic of the industry rather than of the individual, reflecting options as much as optimums. Cattle can be efficient in different packages. Some antagonisms may exist between traits that increase efficiency of the cow herd, and those that increase efficiency in the feedlot. However, Notter says none seriously compromise an integrated program of genetic improvement.

"Efficient cows are those that produce calves regularly and easily. Most of the other biological characteristics of the cow herd are negotiable, depending upon markets and production environments," he explains. "The biological efficiency of the growing calf is more directly about balance: high lean growth potential with appetite in synchrony. But the filter of the market, with an association between intramuscular fat and quality, adds art to the science, along with a healthy dose of unpredictability.

"Biological efficiency is the servant of economic efficiency," Notter adds. "And that master is best served by having the biological diversity to rapidly accommodate changes in markets and economic variables." AJ