

Selection for Increased Marbling

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INTRODUCTION

Marbling, thin flecks of intramuscular fat that enhances beef's flavor, is the cornerstone of delicious beef. Today's health-conscious consumers want flavorful, well-marbled beef without any excess outside fat. Most carcasses today that grade USDA Choice have too much external fat cover. Excess waste fat must be trimmed from retail beef cuts and is costly for beef consumers, processors and producers.

Beef producers today have the opportunity to take advantage of superior genetics by using artificial insemination and selecting bulls from National Sire Summaries. Sire Summaries provide genetic insight into what type of calves a particular bull is expected produce. Sire Summaries with carcass trait Expected Progeny Differences (EPD's) should enable producers to select and breed cattle that yield lean, well-marbled beef.

IMPORTANCE TO FLORIDA CATTLE PRODUCERS

Florida is primarily a cow-calf producing state, that markets most of the calves as stockers and feeders to western feeding areas for growing and finishing in feedlots and then slaughtering and processing in nearby major meat packing plants. Feedlot operators desire feeder cattle that will finish uniformly with enough marbling for a quality grade that is acceptable to the retail beef trade. The major meat packers are emphasizing an urgent need for specification beef that is uniform in quality with a small to modest degree of

marbling and a minimum of both outside fat and seam fat. Florida ranchers need to produce calves that can be efficiently grown and finished to produce consistently the specification beef desired by the industry. When cattle numbers increase cyclically, cattle feeders and meat packers are more discriminating. Calves that do not have desirable quality and yield grades for specification beef will be sold at a considerable discount. Specification beef programs, like Certified Angus Beef (CAB) which is a high quality product with strict standards for quality (marbling), are growing rapidly. CAB sold 93.2 million pounds of CAB valued at approximately \$200,000,000 last year, though limited by lack of product. This provides an opportunity for Florida cattle with the required genetic composition to compete for this growing premium market. Only 20.2% of the cattle that visually qualified in 1989 met the carcass requirements for designation as CAB. The majority of the failures were for lack of adequate marbling. In 1992 the qualification rate had dropped to 16%. These data clearly show a need for efficiently increasing marbling to meet the demand of the high quality beef market (personal communication CAB office).

NATIONAL FOCUS

The U.S. beef industry is rapidly seeking methods to enhance operation profitability by promotion campaigns designed to increase beef consumption, and by producing competitively priced products. Recently, it has become critical to be concerned with the nutritive value of beef products, particularly of fat and cholesterol content, since consumers are concerned about diet-health issues. The

recent (1991) National Beef Quality Audit identified as two major concerns of the industry: 1) the problem that excessive fat represents a waste product and contributes to the high cost of producing and consuming beef, and 2) insufficient marbling in today's cattle.

Producers often request information relative to predictability of carcass composition and the availability of sires which are predictable for these carcass traits, and the relationship of outside fat to the inherent ability to marble. In order to produce an array of beef products that are competitively priced and nutritionally acceptable by the consumer and at a profit to the producer, the beef industry must be able to select breeding stock capable of producing the desired retail product. The variation that exists in body composition is vast and under a high degree of genetic control. Accurate genetic estimators of body composition within a breed, when produced under defined resource and management conditions, would allow beef producers to utilize this information to make a profit while targeting their output to meet the needs of specific markets.

A large amount of additive genetic variance exists for most carcass traits. Genetic change through selection in a defined population is dependent on the genetic variability found in that population. The heritability of economically important traits and the genetic associations among these traits define selection programs that would be effective for improvement of a cattle population. Benyshek (1981. *J. Anim. Sci.* 53:49) calculated heritability (h^2) estimates for growth and carcass traits from data on Hereford cattle under commercial conditions. He reported h^2 estimates for fat thickness, marbling score, retail yield and ribeye area of .52, .47, .45 and .40, respectively, when the data were adjusted to a constant age and days on feed. The h^2 estimate of .52 for fat thickness appears to be in general agreement with a range of .40 to .60 reported by Cundiff et al. (1971. *J. Anim. Sci.* 33:550) and Dinkel and Busch (1973. *J. Anim. Sci.* 36:382). The h^2 estimate for marbling tended to be outside the range of estimates (.30 to .33) reported by Cundiff et al. (1971) and Dinkel and Busch (1973). The h^2 estimate of .40 for ribeye area is somewhat higher than the value of .25 reported by Dinkel and Bush (1973). Estimates of h^2 for ribeye area ranging from .40 to .76 have been reported (Cundiff et al. 1964. *J. Anim. Sci.* 23:113 and Brackelsberg et al. 1971. *J. Anim. Sci.* 33:13).

In order for producers to meet the demand of the consumer for a lean product and to produce beef economically and at competitive prices, the beef industry must have the genetic technologies available for efficient and predictable production of cattle. The need to identify sires within a breed whose progeny are predictable in terms of performance and exhibit desirable carcass characteristics is paramount today. The American Angus Association is one of the more progressive breed associations in terms of a national sire evaluation program. The Certified Angus Beef (CAB) program continues to be the sales leader in branded or specified beef products. Production and carcass traits have been recorded from progeny of many Angus herd sires. From the records, expected progeny differences (EPD's) for important traits have been computed for individual sires. Production traits include birth weight, weaning weight direct, weaning weight maternal (milk production) and yearling weight. Carcass fat thickness over the ribeye, ribeye area and degree of marbling are recorded for measuring carcass merit of progeny. EPD's for traits are used in selecting herd sires to make directed changes in production traits and in carcass traits. Use of EPD's in sire selection make it possible to select for a single trait and to determine the effects of this selection on the marketability and productivity of stocker-feeder-calves, performance of the brood cow herd and acceptability of beef carcasses by packers. Selecting for marbling, which is the principal determinant of beef quality grade, is essential for producing consistently high quality grading carcasses. Although selection for marbling ability is important, it is even more important to determine how selection for this trait affects other traits that determine operation profitability and consumer acceptance of beef.

NEBRASKA WORK

Ongoing research at the University of Nebraska involves the evaluation of genetic resources to produce marbled, lean beef (R.J. Rasby and C.R. Calkins; personal communication).

A two year study was recently conducted to determine the effect of Angus sires selected for marbling EPD's on feedlot production traits, marbling score, fat distribution and palatability. Six Angus bulls with high and six Angus bulls with low EPD's for marbling were randomly bred to composite cows (MARC II) over two years to calve in the spring. Marbling EPD had no effect on fat thickness ($P > .6$) or finishing efficiency ($P > .6$). Over 70% of the carcasses from sires with high EPD for

marbling graded USDA Choice versus less than 50% from low marbling EPD sires (Table 1).

FLORIDA WORK

Ongoing work at the North Florida Research and Education Center (NFREC), Quincy and the Beef Demonstration Unit, Chipley, involves the evaluation of Angus sires selected for carcass quality (marbling EPD), and to determine the effects of selection for increased marbling ability on growth traits, reproductive and maternal traits of their progeny. In the spring of 1990 approximately 100 purebred Angus cows at the NFREC-Quincy were bred artificially to bulls selected from the 1990 National Angus Sire Summary based on milk, ribeye area or marbling EPD's. In 1991 the project was altered in order to concentrate on the selection for marbling within the Angus breed. Since 1991 the Angus cowherd at NFREC-Quincy has been assigned as follows:

Control Herd: Approximately 30 cows were assigned as a control line. Five Angus bulls were selected from the 1991 National Angus Sire Summary that were average (0-EPD's) for marbling and breed average in all other traits (Table 2). These five bulls will continue to be mated artificially to the control line through the duration of the project.

Marbling Herd: Approximately 70 cows per year have been mated artificially to Angus bulls selected for high marbling EPD. Sires are selected on the basis of being in the top 10% for marbling EPD and with a minimum accuracy value of .5 (Table 3). The objective is to use seven bulls per year that are representative of the Angus breed in all traits and superior for marbling.

Polled Hereford and Brahman bulls have been used as clean-up sires following the A.I. breeding season. Feedlot performance and carcass data from the 1991 (NFREC) Angus and Polled Hereford sired steers are presented in Table 4. Carcasses from steers sired by positive marbling EPD sires had higher marbling scores and quality grades than those sired by negative marbling EPD sires. Feedlot performance and carcass yield grades were not substantially affected by sires marbling EPD.

SUMMARY

The ability to grade choice is becoming increasingly important in today's cattle industry. National Sire Summaries which provide carcass EPD's offer producers the opportunity to balance production and carcass traits in their selection programs. Preliminary results from Nebraska and Florida indicate that bulls selected from the National Angus Sire Summary can be used to sire progeny that possess the inherent ability to grade choice without sacrificing yield grade or animal performance.

TABLE 1. Effect of Sire's Marbling EPD on Production Traits and USDA Quality and Yield Grade (Nebraska data).

Sire Marbling EPD	Steers ^{a,b} n = 131		Heifers ^c n = 125	
	Low	High	Low	High
Birth wt., lb. ^d	93	95	86	86
Weaning wt., lb. ^{de}	529	505	507	474
Initial feedlot wt., lb. ^{de}	639	613	739	708
Final feedlot wt., lb. ^{de}	1102	1096	1109	1067
ADG, lb./d	2.93	3.06	3.15	3.06
Dry matter intake, lb./d ^d	19.05	19.47	24.36	22.93
Finishing gain/feed ^d	.155	.157	.129	.133
% USDA Choice	47	77	47	72
Yield grade ^d	2.82	2.90	2.52	2.47

^a Sex x slaughter date for all measurements ($P > .1$), thus data were pooled.

^b 261 d of initiation of feedlot phase.

^c 405 d of initiation of feedlot phase.

^d Sex effect ($P < .01$).

^e Marbling EPD effect ($P < .01$).

TABLE 2. Control Line Sires (NFREC Project) - 1991 National Angus Sire Evaluation^a.

Sire	Birth wt.		Wean. wt.		Wean. wt. Maternal			Yearling wt.		Carcass wt.		Marbling		Ribeye	
	EPD	ACC	EPD	ACC	Milk		Combined	EPD	ACC	EPD	ACC	EPD	ACC	EPD	ACC
					EPD	ACC									
Paramount Ambush 2172	+ .2	.86	+28	.84	+11	.49	+25	+45	.73	+10.6	.53	+19	.57	+03	.60
RA Power Play 501	-.8	.83	+19	.80	+8	.42	+18	+35	.66	+14.6	.55	+09	.59	-.09	.61
SAF Power Fix	+1.0	.88	+24	.87	+14	.40	+26	+40	.72	+15.1	.49	+08	.53	-.13	.56
QAS Traveler 23-4	-.1	.98	+20	.98	+17	.95	+26	+43	.96	+11.3	.90	+06	.92	+07	.93
Tehama Bando 155	-1.2	.95	+25	.94	+20	.81	+33	+48	.89	+5.0	.53	-.05	.57	-.06	.60

^a EPD selection guidelines for control sires.

Birth (Max.)	Wean. wt.	Milk	Year. wt.	Marbling	
				Min.	Max.
+2.0	+15	+3	+28	-.2	+2

TABLE 3. Marbling Line Sires (NFREC Project) - 1993 National Angus Sire Evaluation

Sire	Birth wt.		Wean. wt.		Wean. wt. Maternal			Yearling wt.		Carcass wt.		Marbling		Ribeye	
	EPD	ACC	EPD	ACC	Milk		Combined	EPD	ACC	EPD	ACC	EPD	ACC	EPD	ACC
					EPD	ACC									
Hoff Esso SC 433	+3.8	.94	+20	.93	+12	.87	+22	+50	.88	+22.8	.49	+45	.50	+13	.50
SA Direct Drive 83	+6.8	.90	+23	.89	+7	.81	+19	+38	.84	+24.1	.69	+44	.69	+16	.69
Premier Independence KN	+4.1	.97	+17	.97	+15	.95	+24	+23	.96	+15.4	.89	+35	.89	+38	.89
R&J Justice 1359	+4.5	.85	+30	.84	+4	.75	+19	+48	.79	+11.9	.52	+30	.53	+22	.53
VDAR New Trend 315	+4.6	.95	+34	.94	+21	.82	+38	+58	.88	+16.0	.75	+26	.76	+34	.76
Confederate	+2.2	.92	+19	.91	+5	.86	+15	+31	.87	+12.5	.57	+25	.58	+13	.58
Finks 5522-6148	+1.0	.41	+34	.37	+12	.15	+29	+58	.28	+11.3	.64	+25	.65	+07	.65
Hoff Hi Spade SC 491	+3.8	.97	+45	.97	+13	.92	+35	+80	.94	+26.2	.80	+24	.81	+03	.81
DV Star Plus	+6.5	.85	+40	.83	+23	.54	+43	+64	.75	+7.4	.62	+21	.62	-08	.62
VDAR Valient	+4.2	.89	+35	.87	-6	.75	+12	+58	.81	+15.5	.42	+20	.42	+21	.42
Dakota Express of Ideal 290	+5.7	.82	+25	.80	-6	.63	+7	+51	.74	+18.3	.48	+20	.49	+23	.49
VDAR Receiver	+4.1	.77	+24	.75	+6	.57	+18	+42	.66	+6.6	.55	+17	.56	+16	.56

TABLE 4. Means for Feedlot Performance and Carcass Data as Affected by Sire's Marbling EPD.

Trait	(Florida data). ^a		
	Positive Marbling EPD Sire Group, n = 16	Negative Marbling EPD Sire Group, n = 6	Polled Hereford Sire Group, n = 12
Initial feedlot wt., lb.	652	670	606
Final feedlot wt., lb.	1085	1090	1044
ADG, lb./d	2.66	2.35	2.86
Days on feed	163	179	153
Hot carcass wt., lb.	624	622	583
Dressing %	59.03	59.37	58.83
Fat over eye, in.	.43	.41	.48
Marbling score ^b	435	375	418
Ribeye area, in. ²	11.03	11.55	11.23
KPH, %	2.06	1.75	1.96
Quality Grade ^c	606	568	598
# USDA Choice	13/16	2/6	9/12
Yield Grade	2.9	2.6	2.8
WBS, lb.	10.6	10.0	9.6

^a Positive Marbling Group: mean sire marbling EPD = .11; mean sire ribeye EPD = .27. Negative Marbling Group: mean sire marbling EPD = -.13; mean sire ribeye EPD = .29.

^b Marbling Score: 300 = slight; 400 = small; 500 = modest.

^c Quality Grade: 700 = Prime; 600 = Choice; 500 = Select.