RELATIONSHIP OF MUSCLING TO PRODUCTION TRAITS

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INTRODUCTION

Beef cattle exist because they are a means for converting forages -- a non-human food resource --, and to a lesser extent, excess grains and by products, into a tasty, nutritious and healthful human food -- BEEF. This will continue to be the role of beef cattle.

A sound breeding program will concentrate on improving the traits that are of great economic value -- adaptation, reproduction (early puberty, fertility, calving ease), maternal ability, growth rate and carcass value (yield and quality). Most of the beef cattle breeding research in Florida has been concentrated on the first three of these; adaptation, reproduction and maternal ability.

Attitudes of consumers and resulting reaction by the major meat packers and retailers have led to greatly reduced outside fat on retail beef cuts in the U.S. Most of this reduction of fat on retail cuts has, however, been due to trimming by the packers and retailers. The U.S. block-beef supply consists of about 5% Yield Grade 1, 46% Yield Grade 2, 42% Yield Grade 3, 5% Yield Grade 4, and 2% Yield Grade 5. Dr. Gary Smith (1988) stated that industry needs are 20% Yield Grade 1 and 80% Yield Grade 2, and no carcasses of Yield Grades 3, 4 and 5. His rationale was based on the fact that the average Yield Grade 3 carcass, with 34.9% separable fat, is still too fat to be acceptable to the supermarket trade.

Excel Corporation presently has a system of premiums - discounts based on muscling and cutability, and it is likely that other packers will soon follow suit. It should be obvious, therefore, that it is time for the Florida cattleman to start placing some emphasis on the last two traits listed in the second paragraph: growth rate, carcass yield and quality.

HOW DO FLORIDA CATTLE MEASURE-UP?

Beef cattle breeding programs used in Florida must:

1. Improve carcass cutability and quality,
2. Continually improve the ability of the cows to reproduce annually and to wean heavyweight calves,
3. Produce feeder-stocker calves that grow rapidly and efficiently on forage and (or) concentrate feedstuffs in both warm and cool climate regions of the U.S.

The need for improved muscling in Florida calves is clearly shown by the data presented in Table 1. Nearly half of the calves sold through Florida auctions graded U.S. No. 2 for muscle-thickness. Since the sale price for No. 2's averaged $10 to $15 per hundred weight less than the average paid for No. 1's, this represents a loss in potential profit of $40 to $60 for each 400-weight calf.

TABLE 1. USDA GRADE DISTRIBUTIONS OF CALVES SOLD THROUGH FLORIDA AUCTIONS

	% Distribution		
Grade	1985	1986	1987
Large 1	8.2	8.7	8.4
Medium 1	40.2	36.1	38.9
Small 1	8.1	5.3	5.4
	56.5	50.1	52.7
Large 2	8.2	9.7	11.7
Medium 2	27.9	34.2	32.4
Small 2	7.4	6.0	3.2
	43.5	49.9	47.3
	100.0	100.0	100.0

[a]Source - Florida Agricultural Statistics. Livestock Summary 1987.
[b]Average $10-$15 price advantage for #1's over #2's within frame size.

MUSCLING AND PRODUCTION TRAITS

Carcass traits. Research has shown that muscle-thickness score in feeder cattle is related to muscle to bone ratio in the carcass, and that at a given degree of fatness, is related to the amount of saleable lean meat (muscle) obtained from a beef carcass (Tatum, et al. 1986, Table 2). In that study, they purchased 324 yearling steers representing the nine frame x muscle-thickness combinations in the U.S. Feeder Cattle Grades (36 steers per frame x muscle-thickness class, i.e., Large 1, Large 2, Large 3 ----- Small 3). Muscle-thickness classification was based on visual assessment of thickness of rear quarter, forearm and gaskin -- due to muscle expression and independent of differences in fatness. Steers were all fed the same diet and were serially slaughtered at 28-day intervals (days 0, 28, 56, 84, 112 and 140) during a 140-day finishing trial.

At constant carcass weight, the No. 1 steers (heaviest muscled) had a higher percentage of separable muscle, less separable fat and a higher muscle to bone ratio than the No. 2 and 3 steers (Table 2). The No. 2 steers had less separable bone and a higher muscle to bone ratio than the No. 3 steers. When carcasses were adjusted to a constant percentage of fat, the data show that the No. 1 steers had the heaviest weight (1068 lb vs 1002 and 982 lb for No. 2 and 3 respectively), and that the percentage of separable bone decreased as muscle-thickness grade decreased from No. 1 to No. 2 to No. 3. Again, the muscle:bone was

highest for No. 1 steers (3.94:1), followed by the No. 2 (3.73:1) and No. 3 steers (3.51:1).

TABLE 2. CARCASS COMPOSITION OF CATTLE THAT HAD MUSCLE-THICKNESS SCORES, AS FEEDERS, OF NO.'S 1, 2 AND 3.

Muscle-Thickness Grade	Live wt. lb	seperable, % Muscle (M)	Bone (B)	Fat	M:B
		Constant Carcass Wt.[a]			
No. 1		63.4[c]	16.4[c]	20.2[c]	3.93[c]
No. 2		60.8[d]	16.3[c]	22.9[d]	3.73[d]
No. 3		60.5[d]	17.0[d]	22.5[d]	3.48[e]
		Constant fat[b]			
No. 1	1068[c]	62.2[c]	15.8[c]		3.94
No. 2	1002[d]	61.5[d]	16.5[d]		3.73
No. 3	982[d]	60.7[e]	17.3[e]		3.51

[a]Carcass wt. adjusted to geometric mean of 566 lb
[b]Adjusted to a mean of 21.98% fat
[cde]Means in the same column with different superscripts differ (P<.05).
Adapted from Tatum et al. (1986).

The above data agree with those of Kauffman et al. (1973), where they compared carcasses from steers selected for heavy muscling (muscular) and light muscling (non-muscular) (Table 3). The muscular steers were crosses of beef breeds (Charolais crossed with Hereford and Angus, and some Angus x Hereford crossbreds), whereas the non-muscular steers were primarily of dairy breeding.

TABLE 3. COMPOSITION OF PELVIC LIMBS FROM MUSCULAR AND NON-MUSCULAR STEERS

	Muscular	Non-muscular
Fat, %	19.8	18.2
Dissectable bone, %	16.7[a]	20.6
Fat-free muscle, %	63.5[b]	61.2
Muscle:Bone	3.8:1[b]	3.0:1

[a] P<.05
[b] P<.01

The muscular steers had 2.3% more muscle even though they were slightly fatter. If fat were standardized to 20%, and it was assumed that the muscle: bone of the pelvic limb was the same as the entire carcass, then a 1200 lb muscular steer would have about 24 lb more fat-free muscle than equal weight non-muscular steer. Extremes in muscle:bone are found in double-muscled cattle. Kauffman et al. (1976) reported that double muscled Angus and Charolais steers produced carcasses with an average muscle to bone ratio of 5.77:1.

Growth rate. Tatum et al. (1986) reported that muscle-thickness score (U.S. No. 1, 2 and 3) did not significantly influence absolute growth rate. Buchanan et al. (1982), however, reported low, but positive phenotypic correlation between muscling score and growth. They also reported that selection for yearling weight was improved when muscling score was included in the index.

Muscling has often been measured as pounds of retail product per day of age (Cundiff, 1986; Dinkel and Busch, 1973; Cundiff et al. 1971), and as ribeye area (Dinkel and Busch, 1973; Cundiff et al., 1971). Since both of these measures are highly correlated with growth rate, live animal weight and carcass weight, they are really measures of growth, and not of muscling differences among animals of similar sizes and weights. Genetic correlations between different measures of growth and muscling are shown in Table 4.

TABLE 4. GENETIC CORRELATIONS BETWEEN SOME GROWTH AND MUSCLING TRAITS[a]

Measures of muscling	Birth weight	Feedlot daily gain	Age Constant carcass wt	Final weight
Ribeye area	.31	.49,.34	.66	.54
Muscle score	.26			.24
Fat thickness	-.27	-.25,.05	.34	-.56
Cutability	.50		-.33	.74

[a]Adapted from Cundiff et al., 1971; Dinkel anbd Busch, 1973; Koch et al., 1982.

MUSCLING AND COW TRAITS

Extreme muscling has been shown to result in serious reproduction problems. Research has shown that double-muscled cattle exhibit the following characteristics: delayed puberty, reduced fertility, reduced milk production, and increased birth weight and smaller pelvic area resulting in increased calving difficulty (Oliver and Cartwright, 1968; Tinker, 1987). It is probable that selection for extremes in muscling would result in an increased incidence of double muscling, and the associated negative effects on reproduction.

No real data exist on the relationships among variations in muscling within the "normal" range and cow traits. A very extensive breed comparison study at the Roman L. Hruska U.S. Meat Animal Research Center (MARC) at Clay Center, Nebraska (Cundiff, 1988), indicates that reproductive and maternal traits are not 100% related to growth rate and cutability (Table 5).

A relatively large study (MacNeil et al., 1984) was conducted at MARC to investigate the correlations among carcass traits in steers and reproductive and maternal traits in their half-sisters. Two of the carcass traits studied were fat trim and retail product, both of which are highly correlated with carcass Yield Grade (Table 6).

The unfavorable genetic correlations shown in this study suggest that selection for increased growth and cutability (reduced fat trim) could result in delayed puberty, reduced fertility, longer gestation, heavier birth weight, greater

calving difficulty and lower milk production. It should be emphasized, however, that
neither fat trim nor retail product is a direct measure of muscling, but are more measures of mature size, growth rate and fatness at the time the animal reached slaughter weight or age.

TABLE 5. BREED CROSSES GROUPED INTO BIOLOGICAL TYPES ON THE BASIS OF FOUR MAJOR CRITERIA[ab]

Sire Breed	Growth rate and Mature size	Lean to fat ratio	Age at puberty	Milk production
Jersey	x	x	x	x
Hereford-Angus	xx	xx	xxx	xx
Red Poll	xx	xx	xx	xxx
Brangus	xxx	xx	xxxx	xx
Santa Gertrudis	xxx	xx	xxxx	xx
Brahman	xxxx	xxx	xxxx	xxx
Sahiwal	xx	xxx	xxxxx	xxx
Brown Swiss	xxxx	xxxx	xx	xxxx
Gelbvich	xxxx	xxxx	xx	xxxx
Holstein	xxxx	xxxx	xx	xxxxx
Simmental	xxxxx	xxxx	xxx	xxx
Limousin	xxx	xxxxx	xxxx	x
Charolais	xxxxx	xxxxx	xxxx	x
Chianina	xxxxx	xxxxx	xxxx	x

[a]Increasing number of x's indicates higher levels of performance and older age at puberty.
[b]Adapted from Cundiff, 1988.

CONCLUSIONS

1. Florida calves need more muscle.
2. Muscling (muscling score or ribeye area) should be incorporated into a sound bull selection program.
3. Extremes in muscling (double muscled or approaching double muscled) should be avoided.

TABLE 6. GENETIC CORRELATIONS AMONG CARCASS COMPOSITION OF STEERS AND REPRODUCTIVE AND MATERNAL TRAITS OF THEIR HALF SISTERS

Female traits	Steer carcass traits: Fat trim	Steer carcass traits: Retail product
Age at puberty	- .29	.30
Weight at puberty	- .31	.08
Conceptions per service	.21	.28
Gestation length	- .07	.13
Calving difficulty	- .36	-.02
Birth weight	- .07	.30
Progeny preweaning gain	-1.25	-.26

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