THE EFFECT OF COW SIZE, MILK YIELD AND COW CONDITION ON THE CARCASS CHARACTERISTICS AND MEAT QUALITY OF THEIR PROGENY

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INTRODUCTION

Crossbreeding is now a relatively common practice in commercial beef operations in North America. This has been largely stimulated by the importations of European breeds in the late sixties and early seventies. The newer sire breeds have received much attention from many researchers (Smith et al. 1976, Young et al. 1978) particularly in their ability to improve important factors such as feedlot gain, feed conversion and carcass quality. However, little information has been collected on the role of maternal effects in the cow herd after using bulls of different mature size. Milk yield of the dam has been shown to be an important factor in calf weaning weight, and yet there is considerable variation both within and among breeds (Rutledge et al. 197 Butson et al. 1980). Dairy breeds such as the Holstein or Brown Swiss might thus have a role in the crossbred cow, but inclusions of extreme dairy breeds may lead to inferior carcass quality, particularly with respect to muscle to bone ratio. Cow size has been the subject of much research (reviewed by Morris and Wilton, 1976), but little has been published on its possible effects of the carcass characteristics and meat quality of progeny. Cow condition has also been shown to be highly related to reproductive performance (Spelbring et al. 1977), but little has been reported on its effects on progeny carcass characteristics.

The main objectives of this study were to determine the effects of cow factors (cow size, milk yield, cow condition) on the carcass characteristics and meat quality of their progeny.

MATERIAL AND METHODS

Angus, Hereford and Shorthorn cows were bred to produce both straightbred and crossbred calves and by the larger beef breeds including Charolais, Chianina, Limousin and Maine-Anjou and dairy breeds such as Jersey, Ayrshire, Holstein and Brown Swiss. These matings produced female offspring which had an extremely wide range in both mature size and potential milk yield. All heifer calves were reared on a conventional diet of corn silage with a minimum of grain supplementation and bred to Angus sires to calve at two years of age. Angus sires were used to minimize calving difficulty. As many as possible were retained to produce second and third calves. All cows were bred to a Simmental bull.

All calves from both the Angus and Simmental matings were weaned at six to seven months of age and transferred to the feedlot section of the research centre. These animals were fed a corn silage diet supplemented with some high moisture corn late in the feeding period to achieve 10 mm backfat in the case of Angus sired calves and 7 mm backfat in the case of the Simmental sired calves. Backfat was measured ultrasonically at the 11-12th ribs using a Scanogram.

All animals were slaughtered at the University of Guelph abattoir following established procedures. One side of all the carcasses was separated into fat, lean and bone after hanging for 7 days. The M. longissimus (L.D.) from the 9-10-11th ribs was removed from the dissected residues, vacuum packaged and stored at $-29^{o}C$ for later quality determinations.

The roasts were later selected from the freezer by a process of stratified randomization. Roasts were put into one of the three groups based on the animal's dam size (small, medium, large) and selected from these groups at random. All roasts were thawed at room temperature for 24 hours and then dry roasted at $177^{o}C$ to an internal temperature of $72^{o}C$. For sensory evaluation 1.3 cm cubes were cut from the 9-10th rib of the L.D. and allowed to equilibrate to room temperature ($21^{o}C$). The cubes of meat were scored for juiciness (impression after continued chewing) flavour, tenderness and overall acceptability by an 8 member semi-trained panel on an unstructured 15 cm scale. Meat samples for objective measurements were taken after cooking from the 11th rib adjacent to those used for sensory evaluation. These cores, 2.54 cms in diameter were taken across the face of the L.D. and sheared on a Warner Bratzler shear. Shear values were recorded as maximum force in kilograms per 2.54 cm core.

The least squares method described by Harvey (1960) for multiple classifications with unequal subclass numbers was used to study the effect of cow factors on the carcass characteristics and meat quality of their progeny. All variables of interest were considered to be independent continuous variables and were incorporated as regression effects in analyses that also included experimental group, sex of calf and sire within breed. Partial regression coefficients were calculated to show the changes in progeny carcass quality for changes in the cow factors of interest (cow size, milk yield and cow condition). Means were computed both for breed of sire (Angus or Simmental) and sex of calf although the former could not be statistically compared due to confounding of sire of calf and age of dam.

RESULTS AND DISCUSSION

The effects of cow factors on some of the more important performance variables of their calves are shown in Table 1. A 100 kg increase in cow weight gave calves that were 28 kg heavier at slaughter and 14 days longer reaching the heavier slaughter point. The same increment in cow weight produced a 19 kg increase in cold carcass weight. Young et al (1978) found that Charolais sired cows produced calves which were 17 kg heavier than Angus or Hereford sired cows at 452 days of age. Although it is a biological fact that larger cows produce larger calves no other study has shown the regression of calf slaughter weight on cow weight. Quite large increases in calf slaughter weight could thus be predicted by a 100 kg increase in cow weight. Milk yield of

cow had little effect on slaughter age and a 100 kg increase in milk yield only gave a 2.5 kg increase in slaughter weight. Several authors (Notter et al. 1978; Butson et al. 1980) have reported that cow milk yield has an important relationship with calf weaning weight, and selection for increased lactation performance can effect meaningful increases in calf weaning weights. No other study has followed the effect of milk through to the slaughter endpoint, and it appears by this stage milk yield of the cow has very little effect on weight or age at slaughter. Cow condition had an important effect on slaughter endpoint variables. A 1 mm increase in cow fat depth over the rib (Table 1) gave a reduction in 4.3 days in time to slaughter and a decrease in slaughter weight of 5.7 kg. Cows that put on fat on a constant energy intake thus tend to have calves which are early fattening. Sex of calf had important effects on the overall means (Table 1). Steers were older and heavier at slaughter than heifers. Simmental sired calves were also older and heavier at slaughter than Angus sired calves but this could also have included age of dam effects.

Dressing percent of progeny carcasses was not influenced by cow weight, milk yield or cow condition. Angus and Simmental sired calves had similar dressing percents while there was also no difference between steers and heifers. Dressing percent is a much overrated carcass variable which is mainly influenced by gutfill and carcass fatness (Berg and Butterfield, 1976). It is thus not surprising that no differences were found in dressing percent as progeny were slaughtered at similar fatness, and under the same conditions.

Marbling score in progeny carcasses was not influenced by cow weight, milk yield or cow condition. Other studies (Hedrick et al. 1970; Koch et al. 1976) have generally found lower marbling scores when European breeds were compared to British breeds, but the comparisons were not made at the same carcass fatness. Marbling is still considered an important trait in the North American market, but can only be obtained to visible levels in extremely fat carcasses. Other regressions involving meat colour, meat texture and meat firmness were not significant. It can safely be concluded that cow factors have no effect on these variables of subjective judgment when measured in their progeny.

The effects of cow size, milk yield and cow condition on carcass tissue yield in the carcasses of their progeny is shown in Table 2. A 100 kg increase in cow weight gave a 14 kg increase in lean tissue, 1.8 kg increase in fat, and a 3.4 kg increase in bone. Young et al. (1978) found that larger cows gave progeny that had a higher estimated retail product although the data was adjusted to a constant slaughter age of 468 days. Koch et al. (1976) found no difference in retail product in carcasses produced from Angus or Hereford dams, although there is little difference in mature weight between these two breeds. Providing carcasses are at the same fatness there appears to be no inherent advantage to any dam size in terms of saleable product from progeny carcasses. Heavy or light carcasses (<200 kg and >350 kg) are often more difficult to dispose of in the North American market and generally incur discounts. Milk yield as expected had little effect on carcass tissue yields. A 1 mm increase in cow fat depth (Table 2) decreased lean yield by 2.6 kg, fat by 0.4 kg and bone by 0.8 kg. The general implications are that larger cows produce larger calves which are heavier at slaughter and produce more beef. However, the effect of cow weight on progeny lean weight was not large. Large differences in tissue were noted between breed of sire and sex of calf.

The effects of cow size, milk yield and cow condition on meat quality traits of their calves are presented in Table 3. Partial regression coefficients for taste panel variables regressed on cow factors all yielded values of zero. All roasts were found to be quite acceptable by the taste panel which indicated cow factors had no measurable influence on organoleptic qualities of the progeny meat. Similar results were found by Koch et al. 1976, although animals were not slaughtered at constant fatness.

CONCLUSIONS

Larger cows produce cattle which are older and heavier at slaughter although there is no evidence from this study that cow weight had any influence on progeny meat quality. Milk yield had little effect on carcass characteristics or meat quality. Fat cows under a constant feeding regime tend to produce early fattening calves. Fat cows had no effect on progeny meat quality.

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TABLE 1. Effect of cow size, milk yield and cow condition on carcass characteristics of their calves

Dependent Variable	Independent Variable	Partial Regression Coefficient	± SE	R^2	Breed of sire Means		Sex of calf Means	
					Angus	Simmental	Heifer	Bull
Slaughter age (days)	Cow weight kg	0.14	0.026	0.48	430.7	474.6	452.9[a]	460.1[b]
	Milk yield kg	-0.009	0.0036					
	Cow condition mm	-4.3	0.54					
Slaughter weight (kg)	Cow weight kg	0.28	0.028	0.67	392.9	479.3	422.9[a]	470.5[b]
	Milk yield kg	0.025	0.0039					
	Cow condition mm	-5.7	0.59					
Cold carcass weight (kg)	Cow weight kg	0.19	0.019	0.67	229.4	285.1	249.1[a]	278.5[b]
	Milk yield kg	0.013	0.0026					
	Cow condition mm	-3.9	0.39					
Dressing %	Cow weight	0.003	0.0013	0.16	59.7	60.4	59.9	60.3
	Milk yield	0.000	0.0000					
	Cow condition	-0.1	0.03					
Marbling[+]	Cow weight	-0.003	0.0006	0.14	6.1	6.2	6.3	6.1
	Milk yield	0.000	0.0000					
	Cow condition	0.000	0.0000					

Based on 627 records

Regression for subjective estimation of meat colour, carcass texture and carcass firmness were not significant

[+]Marbling measured on a 9 point scale.

[ab]Means for sex were all significantly different ($P<0.05$)

TABLE 2. Effect of cow size, milk yield and cow condition on carcass tissue yield

Dependent Variable	Independent Variable	Partial Regression Coefficient	± SE	R^2	Breed of sire Means Angus	Breed of sire Means Simmental	Sex of calf Means Heifer	Sex of calf Means Bull
Lean weight (kg)	Weight of cow	0.14	0.024	0.66	66.78	84.64	73.02[a]	82.39[b]
	Milk yield	0.006	0.0032					
	Cow condition	-2.6	0.48					
Fat weight (kg)	Weight of cow	0.018	0.0072	0.42	29.24	34.12	31.25[a]	33.38[b]
	Milk yield	0.006	0.001					
	Cow condition	-0.4	0.14					
Bone weight (kg)	Weight of cow	0.034	0.002	0.67	17.81	22.57	19.12[a]	22.34[b]
	Milk yield	0.002	0.0004					
	Cow condition	-0.8	0.06					

Based on 627 records

Regression for muscle bone ratio was not significant (P>0.05)

[ab] Means for sex were all significantly different (P<0.05)

TABLE 3. Breed and sex means for taste panel scores[+] (0-15cm scale)

Dependent variable	Breed of sire Means Angus	Breed of sire Means Simmental	Sex of calf Means Heifer	Sex of calf Means Bull
Flavour cms	7.71	8.41	8.01	8.39
Juiciness	8.20	8.56	8.35	8.75
Tenderness cms	7.93	8.61	8.20	8.53
Overall acceptability cms	7.80	8.17	7.93	8.25
Shear force kg	5.03	6.13	5.47	5.48

Based on 124 records

[+] Cow factors all gave a partial regression coefficient of zero

All sex means were not significant (P>0.05)