Usefulness of MARKET DOUBLE MUSCLING gene

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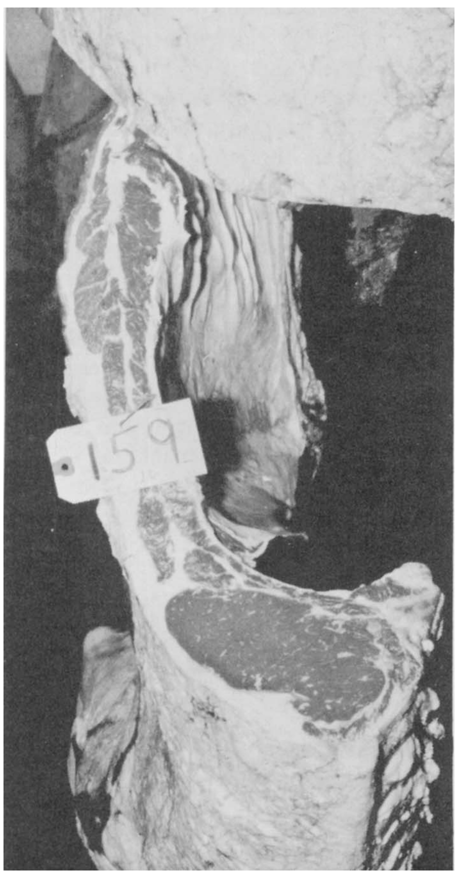
Carcass, above, and rib eye, below, of an m+ steer in experiment 2. This rib eye measured 16 square inches; the carcass had a quality grade of low choice, a modest-degree of marbling, a cutability score of 53.1% and weighed 648 pounds. Pounds of trimmed retail cuts per day of age was .91.



Research results presented here indicate a 10% advantage for double-muscled × normal calves in terms of pounds of trimmed retail cuts per day of age at marketing. No undesirable side effects occurred in either production or performance, and there was little or no reduction in carcass quality grade at marketing.

DOUBLE-MUSCLED CATTLE have been reported as producing carcasses with 20% to 130% more lean meat and 30% to 50% less fat than normal cattle. Furthermore, due to reduced offal weight, double-muscled animals dress higher.

Double muscling results from the inheritance of a genotype homozygous for the mutant gene *m*. The following symbolism is used in this report: *m* = the gene for muscular hypertrophy (double muscled); and + = its normal allele. For the genotype *mm*, the corresponding phenotype is the typical double-muscled animal which is extreme in appearance. For the genotype *m*+, the phenotype is on the average more muscular than the normal type, but does not appear double muscled. The genotype ++ corresponds to the normal type.

The typical double-muscled (*mm*) animal is not at present a useful market animal for the United States beef industry because of undesirable side effects, such as calving problems, reduced viability, and questionable meat quality (tender, but too dry and bland in flavor).

It therefore seems logical to compare heterozygous (*m*+) with normal (++) under controlled conditions to ascertain if *m*+, as an intermediate type, might have a useful net balance of advantages over disadvantages endowed by the *m* gene, making it superior to the normal type as a market animal.

Experiments

To study the two breeding systems, *mm* bulls were crossed with ++ cows to produce *m*+ market calves, and ++ bulls were crossed with ++ cows to produce ++ market calves. The University of California, Davis, experiments reported here compared the two breeding systems for conception rate, ease of calving, postnatal viability, weaning weight, postweaning gains, feed efficiency of postweaning gains, dressing percentage, and carcass yield and quality grades. In the experiments feedlot rations used contained about 70% total digestible nutrients (TDN).

In the first trial, the *m*+ calves were sired by two unrelated, unregistered *mm* Angus bulls purchased as calves, one from a commercial herd and the other from a registered herd. These particular bulls were used because they were the only *mm* bulls of breeding age available at the time. The ++ calves were sired by a ++ Angus Golden Certified Meat Sire (PRI) in a commercial stud and a ++ Shorthorn bull that had been selected as an average representative of the breed for use in a previous crossbreeding experiment. All calves were out of non-double-muscled cows of straight or mixed Angus, Hereford or Shorthorn breeding.

Since these calves were being used in a companion study that required feeding appropriate for breeding stock until one year of age, it was not possible to put them on a high concentrate ration until they were about 13 months old. The calves were topped out for slaughter on the basis of visual appraisal of finish. They received no DES (diethylstilbesterol). The results of this experiment are summarized in table 1.

In the second trial ten randomly selected *m*+ steer progeny of an *mm* Charolais bull (bought as a calf from a com-

CALVES heterozygous for

mercial herd) were individually fed for slaughter. Going on feed, they received a 30 mg implant of DES, but no DES was fed. We are presenting the data from this trial primarily because the rib eye areas of these animals were well above the range for normal animals of this type. It should be noted that rib eye area of fed cattle is a trait with little genetic or non-genetic variance (hence, little phenotypic variance). The results of this trial are presented in table 2.

In the third trial a Holstein cow purchased from a beef breeder was mated to three different *mm* Angus bulls in successive years and produced three *m+* calves (two males and one female). These calves suckled their mother and were later fed for slaughter. No DES was implanted or fed. One of the males was left intact; the other was castrated. The results of this experiment are summarized in table 3.

In each of the three trials the produc-

The mm Charolais sire used to produce the steers in experiment 2—a 2,000 pound bull with very fine bone.

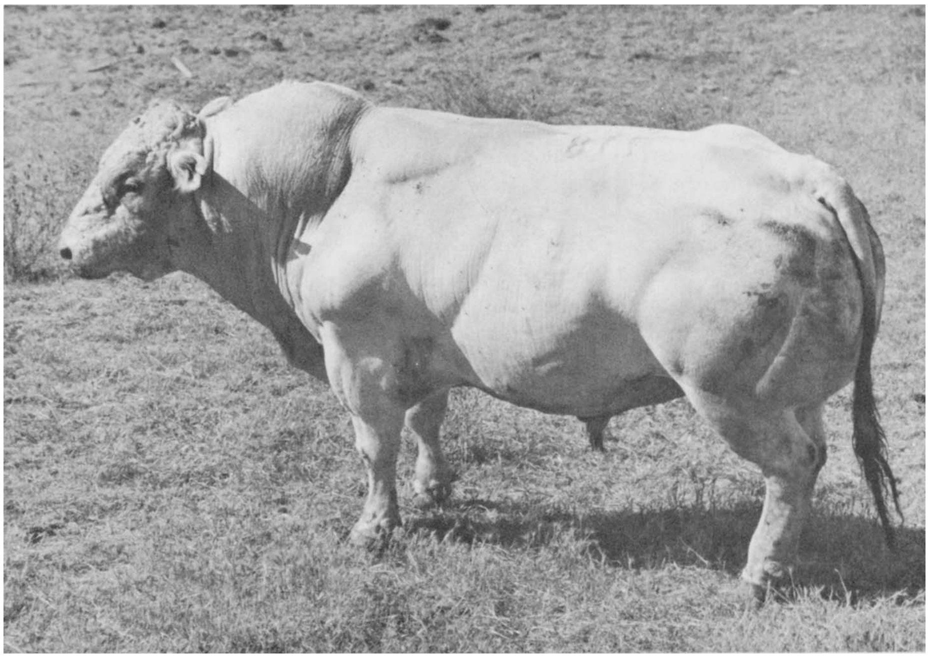
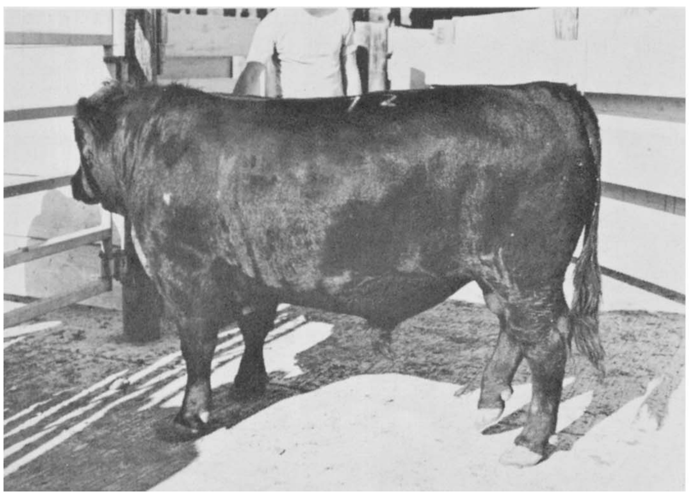
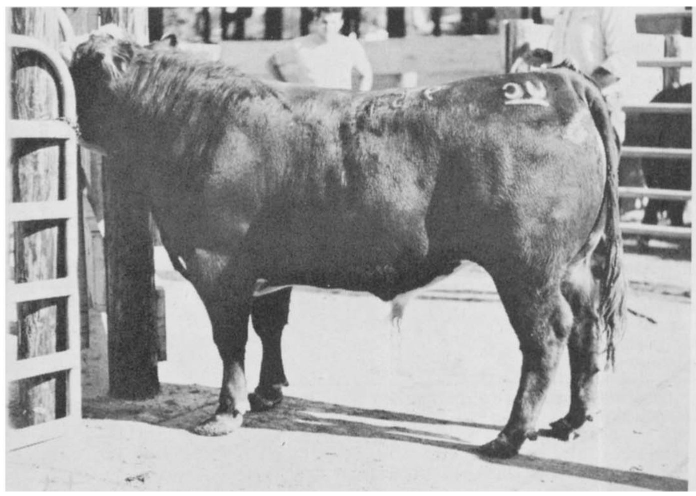


TABLE 1. PERFORMANCE OF m+ AND ++ MARKET CALVES OF ANGUS, HEREFORD AND SHORTHORN BREEDING, EXPERIMENT 1

	Bulls				Heifers			
	m+	++	m+−++	(m+−++)/++ %	m+	++	m+−++	(m+−++)/++ %
Number in group	24	7	. .	. .	15	9	. .	. .
Days on feed	98	104	−6	−5.8	48	57	−9	−15.8
lb TDN/lb gain	5.97	6.15	−.18	−2.9	6.44	7.94	−1.50	−18.9
Slaughter age	493	509	−16	−3.1	436	444	−8	−1.8
Hot carcass weight (lb)	709	679	30	4.6	531	514	17	3.4
Dressing per cent	64.5	62.2	2.3	3.7	64.1	63.1	1.0	1.6
Rib eye area (sq. in.)	15.55	13.86	1.69	12.2	12.00	9.70	2.30	23.6
Fat thickness (in.)	.42	.45	−.03	−6.7	.43	.48	.05	−10.4
Cutability (percentage)*	52.8	51.6	1.2	2.3	51.3	49.4	1.9	3.8
Trimmed retail cuts/day of age (lb)	.763	.692	.071	10.2	.626	.571	.055	9.6
Quality grade†	8.6	8.4	.2	§	9.7	11.1	−1.4	§
Marbling score‡	8.9	9.6	−.7	§	10.4	14.0	−3.6	§

* Calculated according to the American Meat Science Association formula.
† 8 = average good; 9 = high good; 10 = low choice; . . . ; 13 = low prime; etc.
‡ 8 = slight; 9 = slight + ; 10 = small −; . . . ; 13 = modest −; etc.
§ Omitted because the origin of the numerical scale used is arbitrary.





Crossbred bulls from experiment 1 photographed just before slaughter, ++ left, m+ right.

tion of $m+$ calves and their subsequent performance compared favorably with ++ calves for conception rate, calving ease, and viability.

Conclusions

The results presented here indicate about a 10% advantage (a statistically significant result) for the $m+$ market calf in pounds of trimmed retail cuts per day of age, with little or no reduction in carcass quality grade. Furthermore, no undesirable side effects occurred in the production or performance of these calves. This study has also demonstrated the feasibility of producing $m+$ market animals by mating *mm* bulls to ++ cows, using artificial insemination.

The University of California, Davis, has *mm* breeding bulls that can supply semen for cooperators, cattlemen or dairymen interested in further testing the usefulness of $m+$ beef or beef *x* dairy market calves.

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TABLE 2. EXPERIMENT 2
PERFORMANCE OF m+ MARKET CALVES PRODUCED BY CROSSING AN mm CHAROLAIS SIRE WITH COWS OF ANGUS, HEREFORD AND SHORTHORN BREEDING

Number in group	10
Days on feed	155
lb. TDN/lb gain	4.54
Slaughter age	387
Hot carcass weight (lb)	655
Dressing per cent	64.7
Rib eye area (sq. in.)	14.30
Fat thickness (in.)	.41
Cutability (percentage)*	52.0
Trimmed retail cuts/day of age (lb)	.886
Quality grade†	9.7
Marbling score‡	10.4

* Calculated according to the American Meat Science Association formula.
† 8 = average good; 9 = high good; 10 = low choice; . . . ; 13 = low prime; etc.
‡ 8 = slight; 9 = slight +; 10 = small –; . . . ; 13 = modest –; etc.

TABLE 3. PERFORMANCE OF m+ MARKET CALVES OF ANGUS × HOLSTEIN BREEDING, EXPERIMENT 3

Sex of calf	BULL	STEER	HEIFER
Days on feed	168	228	118
lb TDN/lb gain	4.60	5.02	5.70
Slaughter age	364	382	294
Hot Carcass weight (lb)	791	674	600
Dressing percent	66.2	64.5	65.9
Rib eye area (sq. in.)	15.6	14.0	12.3
Fat thickness (in.)	.3	.3	.4
Cutability (in percentage)*	52.18	52.77	50.93
Trimmed retail cuts/ day of age (lb)	1.13	.93	1.04
Quality grade†	9	11	9
Marbling score‡	8	14	9

* Calculated according to the Amerian Meat Science Association formula.
† 8 = average good; 9 = high good; 10 = low choice; . . . ; 13 = low prime; etc.
‡ 8 = slight; 9 = slight +; 10 = small –; . . . ; 13 = modest –; etc.

RAPID, UNIFORM WARMING OF CANNERY PEARS

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Pears in a simulated bin were warmed for ripening from 30° to 68°F in 15 and 25 minutes with 110°F air forced through the bin with air flow rates of 2 and 1 cubic ft per minute per pound of fruit, respectively. Pears held for up to two hours in the warm, rapid air flow were not adversely affected. Pears ripened to processing firmness in three to four days when warmed to 68°F in four hours or less. Fruit delayed in warming from one to seven and one-half days was delayed in ripening in almost direct relation to the time required to reach 68°F. Slow warming resulted in uneven ripening with soft and hard fruit in the same bin. The concept of a warming tunnel to attain uniform ripening and allow a processor to precisely program a canning schedule is suggested.

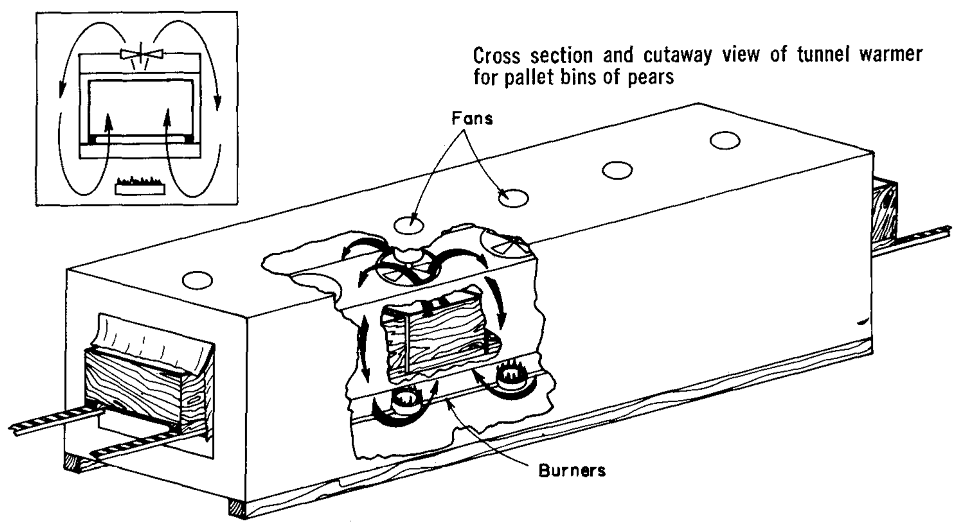
BARTLETT PEARS stored and subsequently ripened in bins often show extreme variation in degree of ripeness at time of processing, with both hard and mushy fruit within the same bin. Unless care is taken to insure prompt, uniform warming, the time required to attain the ideal ripening temperature of 60°F may vary by as much as five to seven days between the most and least accessible fruit within a bin. This study developed a method for rapid and uniform warming of Bartlett pears and compared its effect with that of delayed warming on rate of ripening and fruit quality.

A 24-inch-deep box lined on the sides with foam padding and with approximate inside dimensions about 13 inches square was used to simulate a vertical core of fruit in a pallet bin. The bottom was vented like a bin with two ½-inch wide slots across the bottom.

The box was filled with about 95 lb of pears and placed on a fan chamber to draw (or force) air through it. Temperatures were recorded at the surface, core, and approximately ⅜ inch beneath the surface of four 3-inch diameter pears located at the top and bottom of the test bin. Pears at 30°F were placed in the bin core and the unit was placed in a 110°F room with the fan operating to draw warm air through the test bin. When the average temperature of the downstream fruit reached 68°F, the fan was stopped and the test chamber was moved to a 68°F room, where the fruit temperature was allowed to equalize. This testing procedure simulated the concept of a tunnel bin warmer that would convey bins through a heating chamber, forcing 110°F air vertically through the bin to rapidly warm the fruit (see sketch), and deliver the bins to a 68°F ripening room.

When an air flow of 2 cubic ft per minute per pound of fruit (cfm/lb) was used, pears were warmed to an average 68°F in 15 minutes. The surface temperatures, before removing from the warm room, ranged from 79° to 84°F and core temperatures from 44° to 51°F. Internal fruit temperatures equalized to 68°F ± 3°F in 30 minutes. A pressure of 3.6 inches (water gauge) was needed to force air at this rate through the bin. At 1.0 cfm/lb and an air pressure of 0.8 inches w.g., the average fruit warmed to 68°F in 25 minutes.

Fruits that were warmed to an average of 68°F in 15 minutes ripened uniformly to excellent quality in four days (graph 1). Lots held in the warmer for longer



Cross section and cutaway view of tunnel warmer for pallet bins of pears