NSW GOVERNMENT Department of Primary Industries

primefact

Cow muscularity and maternal productivity

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Background

There is a perception in the Australian beef industry that market signals for enhanced carcase yield could have adverse impacts on maternal productivity traits, through decreased fatness or increased muscling in breeding cows. Higher visible muscling increases dressing percentage and saleable meat yield at slaughter, and the value of animals with higher muscling is recognised in the marketplace. However, Australian cattle producers have avoided selecting for increased muscling in females under the belief that it may result in reduced maternal performance, particularly during the inevitable tough times that can be experienced under pasture-based agriculture.

The muscling herd

The NSW DPI muscling herd was developed to study the effects of selection for increased muscularity in British-type cattle breeds. Initially Hereford cows were crossed to Angus bulls selected for low or high visual muscle score (McKiernan 2007). Visual muscle score was used to select heifer offspring into Low or High muscled lines, which were joined to low or high muscled Angus bulls respectively. A double muscling gene (821del11 myostatin mutation) was introduced into the High line through an Angus stud which was using the gene to generate superior muscling. A third cow line (High^{Het}) with one copy of the myostatin mutation was then formed. After several generations of selection, the cow herd is predominantly Angus breeding.

The research

Australian cattle herds need to be able to cope with the variation in available nutrition that is experienced by pastoral operations. Research on the maternal productivity of the herd was therefore conducted under conditions of both good and poor nutrition. In particular, conditions of continually restricted nutrition were imposed on the herd for two years to test how the lines performed when challenged. First calf heifers were not subjected to the poor nutritional treatment, hence all results are presented for lactating cows aged three years and over.

Weight and body composition

Under what might be considered reasonable pastoral nutrition, there was no difference between the three cow lines in weight (Table 1 and Plate 1). The Low cows had the smallest muscle scores and scanned eye muscle area (EMA), High^{Het} had the largest, and High cows were intermediate. Conversely, the Low cows had the highest levels of fat, High^{Het} the least, and High cows were intermediate. There was also a slight decrease in hip height, or frame score, with increased muscularity in this herd.

Table 1. Average body composition of cows in the muscling herd lines on GOOD nutrition.

	Low	High	High^{Het}
Weight (kg)	547	548	550
EMA (cm^2)*	55	60	64
Rump fat (mm)*	12.4	9.5	6.7
Muscle score*	D-	C+	B
Hip height (cm)	128	126	126

* Ultrasound scanned eye muscle area (EMA) and rump fat values; muscle score = E- (very poor muscling) to A+ (very high muscling)

Under the poor nutritional treatment, cows were around 100kg lighter than under good nutrition (Table 2). The level of nutritional restriction was similar to those experienced in a mild drought, where feed availability and quality is restricted and lactating cows utilise their body reserves for maintenance and to feed their calves.

Plate 1. Examples of Low (top), High (middle) and HighHet (bottom) cows under good nutrition.

Plate 2. Examples of Low (top), High (middle) and High^{Het} (bottom) cows under nutritional restriction.

Under these conditions the High^{Het} cows were a little lighter than the other two lines. All lactating cows utilised most of their external body fat and a significant amount of their muscle (Plate 2) on poor nutrition. It was apparent that the cows mobilised their tissues roughly in proportion to their body composition, and the tissues they had available for use.

Table 2. Average body composition of cows in the muscling herd lines over two years on POOR nutrition.

	Low	High	High^{Het}
Weight (kg)	458	463	450
EMA (cm^2)*	36	39	42
Rump fat (mm)*	2.8	1.8	1.7
Muscle score*	E+	C-	C
Hip height (cm)	129	127	125

* Ultrasound scanned eye muscle area (EMA) and rump fat values; muscle score = E- (very poor muscling) to A+ (very high muscling)

Calving traits and maternal productivity

The productivity of the herd was evaluated for 10 years without intentional nutritional restriction. Drought conditions were experienced at times during this period, but the herd maintained reasonable condition for most of the time. Under these conditions the three muscling lines performed similarly. There were no significant differences between the lines in days to calving, calf birth weight, live calving rate, weaning rate or calf weaning weight (Table 3). Weights of calves weaned per cow joined per year were similar for the three lines. This simple measure of maternal productivity indicated that there was no difference in the performance of the three lines over 10 years of normal grazing conditions.

Table 3. Calving traits and maternal productivity of cows in the muscling herd lines over 10 years on FAIR to GOOD nutrition.

	Low	High	High^{Het}
Days to calving*	310	308	307
Calf birth weight (kg)	35.6	35.5	34.1
Calf wean weight (kg)	245	249	247
Live calving rate*	92	93	92
Weaning rate*	89	90	87
kg calf weaned/cow joined/year	218	225	216

Days to calving = days from start of joining to calf birth; Live calving rate = percentage of joined cows that produced a live calf; Weaning rate = percentage of cows joined that weaned a calf.

The two years of restricted, or poor, nutrition led to a reduction in performance of all three lines. Cows were maintained at a low enough body weight to reduce calving and weaning rates, and calf weaning weights (Table 4). Whilst the Low and High lines performed similarly to each other, the High^{Het} cows showed a significantly lower level of performance under these conditions. This is shown most clearly in the weights of calf weaned per cow joined per year, where the High^{Het} cows produced around 30% less than the Low and High cows. There was no difference between the three lines in the ability of the cows to maintain good welfare under the imposed conditions.

Table 4. Calving traits and maternal productivity of cows in the muscling herd lines during two years on POOR nutrition.

	Low	High	High^{Het}
Days to calving*	310	313	320
Calf birth weight (kg)	32.7	33.4	33.0
Calf wean weight (kg)	175	171	158
Live calving rate*	79	79	58
Weaning rate*	79	77	58
kg calf weaned/cow joined/year	138	132	92

Days to calving = days from start of joining to calf birth; Live calving rate = percentage of joined cows that produced a live calf; Weaning rate = percentage of cows joined that weaned a calf.

Conclusion

Cattle producers can be confident that selecting for higher muscularity within British-type breeds is not likely to reduce the productivity of the cow herd, even under significant nutritional restriction. However, although cows with the 821del11 myostatin mutation will have similar performance to those without it under average to good nutritional conditions, there is a risk that cows with this mutation may have reduced performance under long term nutritional restriction. The chance of unknowingly introducing the gene through selection for increased muscling is slim as the occurrence in British-breeds is very small.

More information

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Other reading

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