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Including muscularity in Holstein-Friesian dairy breeding goals

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Introduction The role of the dairy herd as a provider of beef has proportionately reduced as the dairy animal has become more specialised over the years. High milk production per cow and a decreasing national herd has resulted in a reduction in calves born, and genetic changes have led to dairy bred bull calves being less suited to beef production. This has led to the market for purebred dairy bull calves being severely curtailed and, in some instances, the male purebred calf has had no value. The study develops tools to allow Holstein-Friesian (HF) dairy breeding goals to include muscling and carcass quality to help improve the value of dairy bred bull calves as beef animals.

Materials and methods The predicted transmitting abilities (PTAs) for carcass traits (Irish Cattle Breeding Federation) were correlated with those for production traits (milk, fat and protein) and fitness traits (somatic cell count, SCC; lifespan, LS; calving interval, CI; and non-return rate after 56 d, NR) produced in September 2007 (DairyCo breeding+). The carcass traits, estimated for HF sires in Ireland are carcass weight (CWT, kg), adjusted carcass conformation score (CCON), and adjusted carcass fat score (CFAT). The carcasses were classified at the abattoir using the EU beef classification scheme for conformation (EUROP) and fat class (1-5). The minimum reliability for inclusion in the correlation estimation for the carcass traits was 70-80% and for production and fitness traits 80-90%. The PTAs were used to estimate approximate genetic correlations by accounting for the reliability of the PTA in the estimation of the correlation (Hickman *et al*., 1969; Calo *et al*., 1973). The goal of the current national selection index for dairy cattle in the UK (£PLI) is profit and includes a range of production and fitness traits, including those listed above. Phenotypic and genetic parameters between the traits in £PLI and carcass conformation were collated from this and previous studies. Using selection index theory (Hazel, 1943) different indices were simulated that changed the goal of £PLI from profitability to a desired outcome for carcass traits. The carcass trait included in the goal was carcass conformation as this trait has the biggest impact on the final value of a carcass.

Results Table 1 shows that there is a moderate correlation between carcass traits and milk production with CCON and CFAT being negatively correlated with milk production traits suggesting that higher producing animals will have unfavourable carcass classification. There is a favourable correlation between milk production and CWT suggesting that higher milk production bulls will produce heavier animals at slaughter. There was no significant correlation between the carcass traits and LS and SCC. There was a significant low to moderate correlation between the fertility traits and CCON, suggesting that bulls producing more highly conformed carcasses will produce daughters that will have better fertility. However, this correlation may be driven through the negative relationship between milk production and CCON. Table 2 shows that selection on £PLI and an index that improves CCON leads to a favourable correlated response in carcass weight, ranging from 0.64 - 0.75 kg improvement per annum. As the desired rate of improvement in CCON increases the expected response in fitness traits (CI and mastitis) is favourable but the rate of improvement in milk production traits decreases.

Table 1 Approximate genetic correlations (standard errors in brackets) between carcass traits and production and fitness traits in HF animals.

	CWT (kg)	CCON (1-15)	CFAT (1-15)
Milk (305d, kg)	0.22 (0.064)	-0.40 (0.060)	-0.34 (0.062)
Fat (305d, kg)	0.23 (0.064)	-0.33 (0.062)	-0.33 (0.062)
Protein (305d, kg)	0.33 (0.062)	-0.26 (0.064)	-0.23 (0.064)
LS (lactation)	-0.07 (0.070)	0.05 (0.070)	0.06 (0.070)
SCC	-0.05 (0.067)	0.07 (0.067)	0.05 (0.067)
CI (days)	-0.04 (0.068)	-0.31 (0.064)	-0.25 (0.066)
NR (0/1)	-0.16 (0.067)	0.10 (0.068)	0.23 (0.066)

Table 2 Expected annual responses to selection in some production, fitness and carcass traits for indices improving carcass conformation

	Milk (kg)	Fat (kg)	Prot (kg)	LS (lacts)	Mastitis (cases)	CI (days)	CCON (1-15)	CWT (kg)
£PLI	40.79	3.40	2.72	0.060	0.0011	0.30	-0.033	0.64
Index with a change in CCON per annum of:								
0	35.11	3.27	2.65	0.054	0.0008	0.21	0.000	0.71
0.02	30.99	3.12	2.55	0.048	0.0007	0.16	0.020	0.74
0.04	26.18	2.91	2.40	0.042	0.0005	0.09	0.040	0.75
0.06	20.71	2.63	2.20	0.035	0.0003	0.03	0.060	0.75
0.08	14.43	2.29	1.95	0.027	0.0001	-0.04	0.080	0.73
0.1	7.26	1.86	1.62	0.017	-0.0002	-0.12	0.100	0.69

Conclusions Selection on an index that improves carcass conformation of HF beef by 0.1 unit will lead to a reduced rate of improvement in production traits and an improvement in fitness traits albeit with a reduction in the rate of improvement in lifespan. These results can be used to develop dairy indices that include “beef” traits in the overall goal.

Acknowledgements The MDC (now DairyCo) and EBLEX are gratefully acknowledged for supporting this work.
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