Multi-Breed Genetic Evaluation for Docility in Irish Suckler Beef Cattle

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Introduction

Poor temperament in beef cattle has been associated with reduced performance, health, and carcass quality in beef cattle (Beckman *et al.,* 2007a). Handling is more labour intensive and time consuming and therefore causes increased productions costs (Grandin, 1989). Aggressive cattle jeopardize stockperson safety and are more likely to become injured during handling (Grandin, 1989). The response to handling can vary from docile, easy to handle to aggressive with docile being the preferred behavioural response for farming conditions (Gauly *et al.,* 2001). The combination of these factors make docility an economically relevant trait (Golden *et al.,* 2000) that should be strongly considered by beef producers when breeding or purchasing cattle. Differences in temperament are quite noticeable and moderately heritable (Le Neindre *et al.,* 1995) so selection pressure can be exerted in a breeding programme to alter or improve temperament (Morris *et al.,* 1994).
Within breed genetic evaluations for docility have been implemented by a various beef evaluation centres including the North American Limousine Federation (Limousine), BREEDPLAN in Australia, (Limousine), ICBF in Ireland (Limousine).

The aim of this paper is to outline the recent development of an across breed evaluation of docility for Irish suckler beef cattle.

Materials and Methods

Data for the study was obtained from the Irish Cattle Breeding Federation (ICBF) database and consisted of two different measures of docility recording.

ICBF trained linear scorers have recorded docility (DOCLIN) since 2002. This service was historically available for pedigree cattle but in recent years the service was expanded to include crossbred animals also. Docility is recorded at the same time as other linear, muscular and skeletal scores. Scores given range from 1 (aggressive) to 10 (docile). Currently there is a within breed docility index published on Limousine pedigree cattle based on docility recorded during linear scoring. A dataset containing 122,397 animals scored for DOCLIN was obtained from the ICBF database. The main breeds represented were Limousine, Charolais, Simmental, Hereford with smaller numbers of other beef breeds. The percentages of DOCLIN scores recorded was as follows: 6%, 16%, 35%, 32%, 9% and 3% for scores of 5 or less, 6, 7, 8, 9 and 10. 16% of DOCLIN scores were on crossbred animals.

In 2008 the Irish Department of Agriculture launched a new voluntary participation scheme for Irish Suckler Herds called the Animal Welfare, Recording and Breeding Scheme for Suckler Herds (AWRBS scheme) (http://www.agriculture.gov.ie). The scheme was open to pedigree and commercial cattle. A component of the scheme involved the farmer recording of docility (DOCFARM) and calf quality on a scale of 1-5. Individuals with scores of 1, 2, 3, 4 and 5 were recorded if the animal was very quiet, quiet, average, difficult or very difficult. All score sheets were submitted to ICBF as part of the scheme. There was also an electronic scoring option through the Department of Agriculture website or the ICBF website. All herds applying for the scheme were obliged to sign up to the ICBF calf registration recording system called Animal Events. Sire recording was also a condition of the scheme offering a major development for beef breeding as this criterion

is not compulsory for calf registration. As a result more than 90% of the calves born in these herds since 1/1/2008 had sires recorded on the database. A dataset containing 597,686 animals scored for DOCFARM was obtained from the ICBF database. The percentages of DOCFARM scores recorded was as follows: 12%, 40%, 44%, 3% and 0.3% for scores of 1, 2, 3, 4, and 5. 96% of DOCFARM scores were on crossbred animals.

Pedigree information on all animals was obtained from ICBF pedigree files used for other genetic evaluations.

Several data edits were imposed before inclusion of data in genetic parameter estimation. DOCFARM scores which were recorded post sale of the animal were omitted (loss of 40,475). DOCAWRBS docility scores were confined to animals recorded between the ages of 150-300 days (loss of 59,534) whereas DOCLIN was evaluated at age 150-300 days and also 150-600 days as 80,645 DOCLIN records were lost when the upper age limit was reduced from 600 to 300 days of age at scoring. Contemporary groups (CG) were defined according to the procedure described by Crump *et al.* (1997) taking into account within herd scoring date patterns. Contemporary groups with no variation in score for either trait were omitted (loss of 170,147 DOCFARM and 1,737 DOCLIN records). An extra edit imposed on the DOCFARM data was that there also had to be variation in the CG for calf quality which was recorded at the same time. Restrictions on minimum CG size were set to a minimum of 10 records for each DOCFARM CG (loss of 7,374 records) and 5 for each DOCLIN CG (loss of 10,532 records). Finally contemporary groups with less than 3 sires for DOCFARM and less than 2 sires for DOCLIN were omitted (loss of 225,497 DOCFARM and 5,319 DOCLIN records). This left a dataset of 73,827 DOCFARM and 18,310 DOCLIN records (72,228 when age limit raised to 600 days) for analysis. A five generation pedigree containing 404,247 animals was created which included genetic groups to account for the multiple breeds represented in the analysis. The genetic parameters were estimated using DMU (Jensen and Madsen, 1996).

Initial univariate analyses were performed for the two different docility traits before a series of bivariate analyses were investigated. Maternal genetic and maternal environmental effects on DOCLIN were also investigated.

The following model was used for the analysis of DOCLIN assuming a simple animal model without maternal genetic or environmental effects:

$$Y_{ijklmnop} = + CG_j + S_k + SCR_l + DAMP_m + AGE_n + HET_o + REC_p + a_i + e_{ijklmnop}$$

The following model was used for the analysis of DOCFARM:

$$Y_{ijlmnop} = CG_j + S_k + DAMP_m + AGE_n + HET_o + REC_p + MEAL_l + a_i + e_{ijklmnop}$$

where:

$Y_{ijklmnop}$	=	DOCLIN or DOCFARM
CG_j	=	Fixed effect of scoring date contemporary group
S_k	=	Fixed effect of sex (male or female)
SCR_l	=	Fixed effect of ICBF linear scoring technician (1-16)
$DAMP_m$	=	Fixed effect of parity of dam (1, 2, ≥3)
AGE_n	=	Age at scoring in days (150-300 days of age, also 150-600 days DOCLIN)
$MEAL_l$	=	Days on meal feeding at time of scoring
HET_o	=	Coefficient of general heterosis
REC_p	=	Coefficient of general recombination
a_i	=	random additive effect of animal i
e	=	random residual error term

Random animal effects and maternal genetic effects were assumed normally distributed. The genetic parameters estimated from the DMU analysis with the DOCLIN upper age limit set to 300 days and no maternal or permanent environmental effect were then integrated into MIX99 (Lidauer *et al.,* 2006) to generate EBVs and reliabilities for routine breeding value estimation. The editing criteria imposed where each DOCFARM required 3 sires and each DOCLIN CG required 2 sires

was relaxed to allow inclusion those CGs with single sire representation. Table 2 shows the breed representation in the database for the 12 predominant breeds in the evaluation. 96% of the animals with DOCFARM were crossbred compared to 39% of the DOCLIN records. The dataset was balanced for sex with some variations within the smaller breeds for DOCLIN.

Results and Discussion

Table 1 shows the details of the two bivariate analyses with DOCFARM and DOCLIN where the upper age limit for DOCLIN was varied between 300 and 600 days. There were 1,238 and 2,304 animals with both types of docility score depending on the age limit (2008 born animals). The heritability of DOCFARM (0.44) was found to be higher than DOCLIN (average of 0.245) irrespective of the age limit set for DOCLIN. As the scoring methodology is opposite for the traits (high scores are favourable in DOCLIN and low scores are favourable in DOCFARM) a negative correlation is indicative of a favourable relationship between the traits. The age limit for DOCLINEAR did affect the genetic correlation between the two traits with the correlation being higher when the age criteria for both traits was the same (-0.68 vs -0.4). Phenotypic correlations were lower but in the same direction. Older animals tended to be more docile for both traits. Increasing levels of heterosis and recombination tended to have an unfavourable effect on both docility measures indicating better docility in pedigree animals. Increased number of days on meal feeding (average days on meal was 66 days) prior to scoring had a positive effect on DOCFARM. Maternal effects for DOCLIN were also tested. As there was only one year of DOCFARM data no maternal effects were applicable. A heritability estimate of 0.04 for DOCLIN was found for maternal genetic effect which is similar to an estimate found in a US Limousine study (Beckman *et al.,* 2007). The log likelihood indicated a better fit with the inclusion of a maternal genetic effect and a maternal environmental effect for DOCLIN compared to the direct effect only. However there was a negative correlation found between direct and maternal DOCLIN of -0.47 which is also close to the estimate of -0.41 found by

Beckman *et al.* (2007) who also found that models with random maternal effects resulted in better fit than direct alone. In a follow up study Beckman and Garrick (2007) concluded that the maternal effect was an artefact of the data. Therefore, ICBF implemented the model without maternal genetic effects for genetic evaluation.

Figure 1 is a stock chart showing the breed average, top 5 percentile and Bottom 5 percentiles of predicted transmitting ability (PTA) for DOCFARM. The Belgian Blue has the highest breed average PTA while the Limousine has the lowest breed average. However these two breeds also have the largest standard deviation hence the largest variation in genetic merit for docility within breed. Analysis of 84 AI sires across all breeds and with >90% reliability for DOCFARM showed an 8% increase in the percentage of progeny scoring 4 or 5 (unfavourable scores) when looking at the Top 20% of sires versus the Bottom 20% of sires on docility. The DOCFARM proofs were released to the industry in Spring 2009 for Active AI sires only. It is planned to release the proofs for stock bulls and cows in September 2009.

Future Developments

A review of the genetic parameters will begin when the 2009 generation of DOCLIN and DOCFARM scores are available at the end of 2009. Further areas of work will focus on examining the maternal and permanent environmental effects. A threshold model will also be investigated and compared to the current linear approach.

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Table 1. Trait variables in bivariate DMU analysis of DOCAWRBS and DOCLIN .

Trait	N-obs	N-obs with both	Avg.	s.d.	Age at scoring (Days)	-2LogL	σ_a^2	h^2 (s.e.)	r_g * (s.e.)	r_p *
DOCAWRBS	73,827		2.36	0.78	222		0.167	0.44 (0.018)	-	-
DOCLIN[a] 150-300 d	18,310	1,238	7.3	1.13	239	24449	0.202	0.25 (0.023)	-0.68 (0.06)	-0.19
DOCLIN[b] 150-600 d	72,228	2,304	7.3	1.14	338	72468	0.201	0.24 (0.011)	-0.40 (0.05)	-0.16

*Correlation with DOCAWRBS, σ_a^2 = direct genetic variance, h^2 = heritability, r_g = genetic correlation, r_p = phenotypic correlation

Table 2. Breed representation in the breeding value estimation dataset, level of crossbred information and female representation for both DOCFARM and DOCLIN.

| **Breed**	**No. of animals DOCFARM**	**% crossbred Animals DOCFARM**	**% female Animals DOCFARM**	**No. of animals DOCLIN**	**% crossbred Animals DOCLIN**	**% female Animals DOCLIN**
Angus	7,893	93%	48%	699	60%	45%
Aubrac	528	72%	48%	367	28%	56%
Blonde D'Aq	1,691	96%	48%	530	65%	48%
Belgian Blue	6,233	99%	50%	1,669	95%	50%
Charolais	4,8322	97%	49%	9,019	44%	48%
Hereford	3,384	89%	50%	561	17%	47%
Limousine	38,195	96%	50%	13,363	28%	47%
Partenaise	7,893	93%	53%	120	48%	53%
Piemontese	325	88%	44%	153	22%	60%
Saler	1,298	92%	51%	337	23%	60%
Shorthorn	1,010	89%	54%	141	55%	69%
Simmental	8,555	94%	50%	3,044	42%	49%
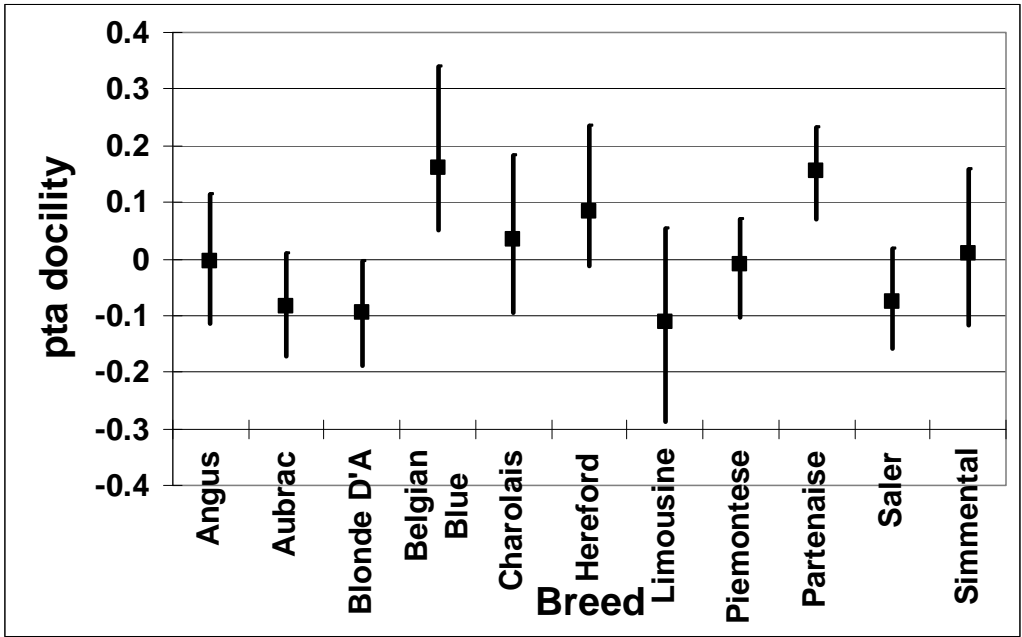
Figure 1. Stock chart showing the breed average, top 5 percentile and Bottom 5 percentile of PTA for pedigree animals for the docility trait DOCFARM.