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Fattening Beef for Froggies
Post-Weaning Evaluations in French Beef Breeds

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Abstract

This paper presents French genetic evaluations using commercial carcass traits of young bulls and on-field post-weaning growth and morphologic traits recorded on heifers and young cows. Pre-weaning traits are taken into account to avoid selection bias. Heritabilities of post-weaning and carcass traits are moderate. Genetic correlations depend on breeds. Index standardisation, construction of total merit indices and rules of publication are presented.

1. Introduction

Improving post-weaning traits (carcass quality, post-weaning growth and morphology) is a major objective in beef cattle breeding. On the other hand, genetic evaluation using commercial data sets are becoming more and more common thanks to computer facilities that allowed rapid exchanges of information and treatment of huge amount of data (e.g. Schild *et al.,* 2003). Accordingly, a carcass traits genetic evaluation has been routinely performed in France since 2002 in Charolais breed (CH), and since 2005 in Limousine (LI), Blond d'Aquitaine (BL), Maine Anjou (MA) and Parthenais (PA) breeds. This evaluation is based on young bulls' commercial carcass data.

Genetic evaluations are also currently being extended to female post-weaning growth and morphologic traits. These genetic evaluations are based on on-field data recorded on heifers and young cows. At this time, two breeds are concerned: Charolais and Limousin.

All data are extracted from the national genetic database (SIG, standing for "Système d'Information Génétique). Genetic evaluations are carried out using a home-made software written in Fortran90 suitable for multitrait analysis considering animal model with optional genetic and permanent environment maternal effects.

The aim of this paper is to present the characteristics of these genetic evaluations. It will focus on the genetic evaluations of carcass and morphology. Future developments of these post-weaning evaluations are addressed.

2. Carcase merit evaluation

2.1- Traits, data and models

French carcass genetic evaluation consists in a within breed multitrait genetic evaluation. Due to selection at weaning that significantly affects EBV's of the most important bulls (Fouilloux *et al.,* 2002), the following traits are simultaneously evaluated.

- Carcass weight (CW), slaughter age (SA) and carcass conformation score (CC, in EUROP scale) of purebred young bulls slaughtered between 10.5 and 25 month of ages. These carcass traits are recorded in slaughterhouses. CCs are registered by specialised technicians from independent organisms.
- Weight at 210 days (W210d) (or at 120 days (W120d) for BL only) and muscular development score at weaning (WMD) of all performance recorded animals involved in the "IBOVAL" genetic evaluation (on-field genetic evaluation from birth to weaning. Laloë *et al.,* 2007). Young bulls with unknown W210d (or W120d for BL) are removed.

Performances are described with an animal model. Maternal effects are also taken into account for weights. Environmental fixed effects were presented by Laloë *et al.* (2007).

2.2- Genetic parameters

Genetic parameters have been estimated using the ASREML software (Gilmour *et al.*, 2002) on a subset of data. A sire model was implemented in the carcass context, considering a genetic maternal grand-sire and an environmental maternal effect for W210d (and W120d).

Estimated genetic parameters are shown in table 1. The heritabilities lie within 0.20-0.32, 0.16-0.22 and 0.12-0.31 for CW, SA and CC respectively. Genetic correlations between CW and SA are negative (-0.39 (PA); -0.31 (CH)) to null (-0.09 (LI); 0.05 (BL)). They are positive (0.28 (LI); 0.16 (CH)) to null (0.00 (BA); -0.02 (PA)) between CW and CC. SA and CC present negative genetic correlations (-0.18 to -0.32) except in PA breed (0.46). Accordingly, weaning traits have to be included in the genetic evaluation in order to account for selection.

2.3- indices and total merit

Table 2 presents the population involved in the later genetic evaluation.

In each breed, selection index related to a breeders profit have been calculated using the most recent French economic parameters. Hence, EBVs of CW and SA are combined into a carcass growth index named ICRCjbf. They are also combined with CC EBV (CONFjbf) to obtain a total merit index for beef ability (IABjbf).

Both economic indices and CONFjbf are standardised using a rolling base composed of young bulls involved in the evaluation whose CW, SA and CC are known and that belong to the last IBOVAL rolling base. Indices means in the rolling base is 100 and standard deviation of ICRCjbf and IABjbf is 8. For CONFjbf, 10 points correspond to the genetic standard deviation for CC.

2.4- publication rules

In order to check the reliability of the carcass genetic evaluation, only accurate indices (ICRCjbf, IABjbf, CONFjbf) of the most used IA sires have been published with their coefficient of determination (CD) until 2007. These three indices have been given a favourable reception by the beef industry. Consequently, they have been made official for

(i) cows with at least 1 young bull with known CC involved in the genetic evaluation and a CD for IABjbf higher than 0.05;

(ii) bulls with at least 25 young bulls with known CC involved in the genetic evaluation and a CD for IABjbf higher than 0.50.

Cows and bulls must also have published IBOVAL indices. Table 2 shows the number of bulls and cows whose carcass indices are officials and will soon be published.

3. Genetic evaluation of morphology.

3.1- Traits, data and models

Traits are recorded at two different ages: at weaning (i.e. mainly between 4 and 7 months), and when cows are about 30 months old. About 20 scores are recorded, and these scores are synthesized in three linear scores, corresponding to three main abilities: Muscular development (MD), Skeletal development (SD), and Functional Abilities (FA).

Since the late 90's, a specific program was set up in the Charolais' areas to test the feasibility of field recorded post-weaning traits evaluations (growth and morphology). After editing, data of 161 171 animals (86 853 animals recorded at weaning and 28 772 recorded at 30 months), were gathered and included in the genetic evaluation.

The model of evaluation is the same for each main ability: It consists of a two-trait model, combining the weaning trait and the 30 months trait. The weaning traits models was an animal model with maternal effects, while the 30 months traits were a direct animal model.

3.2- Genetic parameters

Genetic parameters are in Table 3. Heritabilities are moderate for FA, and high for MD and especially for 30 months-DS (0.46). Maternal heritabilities for weaning traits are low. Genetic correlations between weaning and 30 months recorded traits are high for developments (r=0.72 for both MD and SD), and moderate for FA (r=0.50).

3.3- Indices and publication rules

The resulting selection indices will be expressed according to the same rules than the carcass indices. Accordingly, publication rules will be the same.

4. Future developments and conclusion

Historically, modern field genetic evaluation (Animal model and Blup evaluation) of French beef cattle has been first developed for pre-weaning traits: the so-called Iboval evaluation has been carried out since 1993. Then, the focus was put on carcass traits. The corresponding evaluation became official this year. Thanks to a favourable reception from the beef industry, the amount of available carcass data should dramatically increase within the next years. Moreover, the inclusion of crossbred data is under consideration. Post-weaning growth and morphology are about to be routinely evaluated, and should concern all breeds in the mid-term.

It is worth noting that, in the same time, considerable attention is devoted to the genetic evaluation of female fertility and longevity. French beef industry will soon benefit by genetic evaluations covering all the traits of economical importance.

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Table 1. Estimated genetics parameters of carcass traits and weaning traits.

		W120D	W210D	WMD	CW	SA	CC	mW120D	mW210D
W120D	BL	0.57 / **0.27**	0.73	0.17	0.34	-0.45	-0.02	-0.39	-0.22
W210D	CH		0.66 / **0.25**	0.17	0.40	-0.57	-0.30		-0.36
	LI		0.59 / **0.37**	0.39	0.58	-0.64	0.29		-0.55
	BL	0.82	0.61 / **0.30**	0.20	0.47	-0.49	0.14	-0.13	-0.39
	PA		0.65 / **0.25**	0.32	0.41	-0.38	-0.25		-0.41
WMD	CH		0.43	0.81 / **0.19**	0.24	-0.22	0.53		-0.54
	LI		0.43	0.69 / **0.31**	0.12	-0.43	0.63		-0.70
	BL	0.30	0.35	0.73 / **0.27**	-0.05	-0.44	0.57	-0.05	-0.05
	PA		0.10	0.83 / **0.17**	0.23	-0.03	0.33		-0.09
CW	CH		0.19	0.20	0.76 / **0.24**	-0.31	0.16		-0.25
	LI		0.19	0.13	0.78 / **0.22**	-0.09	0.28		-0.39
	BL	0.20	0.22	0.15	0.68 / **0.32**	0.05	0.00	0.16	-0.05
	PA		0.25	0.09	0.80 / **0.20**	-0.39	-0.02		-0.11
SA	CH		-0.57	-0.18	0.20	0.78 / **0.22**	-0.18		0.29
	LI		-0.45	-0.13	0.28	0.78 / **0.22**	-0.30		0.33
	BL	-0.47	-0.55	-0.14	0.27	0.84 / **0.16**	-0.34	0.78	0.76
	PA		-0.56	-0.04	0.27	0.78 / **0.22**	0.46		-0.11
CC	CH		0.07	0.33	0.55	-0.02	0.76 / **0.24**		-0.30
	LI		0.01	0.15	0.41	0.04	0.76 / **0.24**		-0.50
	BL	0.01	-0.01	0.23	0.42	-0.01	0.69 / **0.31**	0.12	-0.20
	PA		-0.10	0.41	0.28	-0.06	0.88 / **0.12**		0.53
mW120D	BL							0.10 / **0.14**	0.65
mW210D	CH								0.04 / **0.11**
	LI								0.00 / **0.18**
	BL							0.95	0.06 / **0.09**
	PA								0.05 / **0.11**

*W120D and W210D: age-adjusted weights at 120 and 210 days; mW120D and mW210D: maternal effects on W120D and W210D; WMD: muscular development score at weaning; CW: carcass weight; SA: slaughter age; CC: carcass conformation score (EUROP). Diagonal: heritabilities residual/**genetic;** above diagonal: genetic correlations; below diagonal: residual correlations.*

Table 2. Population under carcass evaluation.

	Nb animals	Weaned	Young bulls	Bulls	Cows	Publi	CPU time
Charolais	3 186 617	3 658 394	112 698	10 017 10.9 ± 55.5 [1735]	81 589 1.4 ± 1.7 [9]	451 / 29 807	43h
Limousin	1 709 897	1 507 839	23 717	2 020 11.3 ± 29.3 [919]	17 313 1.4 ± 0.7 [7]	125 / 7 355	22h
Blond d'Aquitaine	593 918	461 856	14 856	1 525 9.2 ± 23.8 [453]	11 668 1.3 ± 0.6 [7]	62 / 5 427	12h
Maine Anjou	123 593	96 032	11 012	968 10.7 ± 22.6 [267]	8 403 1.3 ± 0.6 [7]	51 / 2 806	1h
Parthenais	116 548	104 225	6 951	853 8.0 ± 14.4 [173]	5 580 1.3 ± 0.6 [7]	24 / 1 806	1h

Nb animals: total number of animals under evaluation; Weaned: number of animals with performances at weaning: Young bulls: number of animals with registered carcass traits; Bulls (Cows): number of bulls (Cows) with at least 1 young bulls with registered carcass traits (mean±std [max] young bull/bull (Cow)); Publi: number of bulls / cows whose carcass indices can be published.

Table 3. Genetic parameters of linear scoring traits (at weaning and at 30 months) for Charolais breed.

	Muscular development (Weaning)	**Muscular development (30 months)**	**Skeletal developement (Weaning)**	**Skeletal development (30 months)**	**Fonctional abilities (Weaning)**	**Fonctional abilities (30 months)**
Direct heritability	0.36	0.27	0.28	0.46	0.15	0.18
Maternal heritability	0.05	-	0.06	-	0.04	-
Maternal permanent environment (%)	0.05	-	0.06	-	0.03	-
Direct-maternal genetic correlation	-0.51	-	-0.55	-	-0.48	-
Phenotypic variance	113.53	68.18	65.49	77.29	47.15	47.59
Genetic correlation between weaning and 30 months traits	0.72		0.72		0.50	