Genetic analysis of calf vitality, survival and disease resistance in Charolais beef cattle

A. Vinet, H. Leclerc, F. Marquis, F. Phocas*

World Congress on Genetics Applied to Livestock Production, 11.**573**

12 / 02 / 2018

Background

- Diseases that affect calves have a substantial economic impact on beef and dairy farms.

- The 3 most frequent diseases are
  - diarrhea
  - respiratory disease
  - umbilical infection

- Most cases concern calves that are less than 1 month old.

- Literature on genetics of calf health is scarce.

Aim of the study

Estimation of genetic parameters for calf health traits to answer 2 key questions:

1) Is it feasible to select calf health traits directly ?

2) Can we select health traits indirectly through selection that focuses more generally on the performance of the young calf ?

Material and Methods - Data

- 16 French Charolais herds with at least 3 health events recorded per herd-year recruited from a network of 75 Charolais herds managed by the French Charolais breed society to develop genomic selection for new traits.

- Herds were managed according to a standard suckler herd production system in France with calves reared by their dams until 6 to 8 months of age.

- Data consisted of birth and health performance recording on 2,740 calves born during 2 successive birth campaigns, from August 2013 to July 2015.

- Calves were bred by 2044 dams and 252 bulls with known pedigree for at least 3 generations of ancestors

Material and Methods - Trait definitions

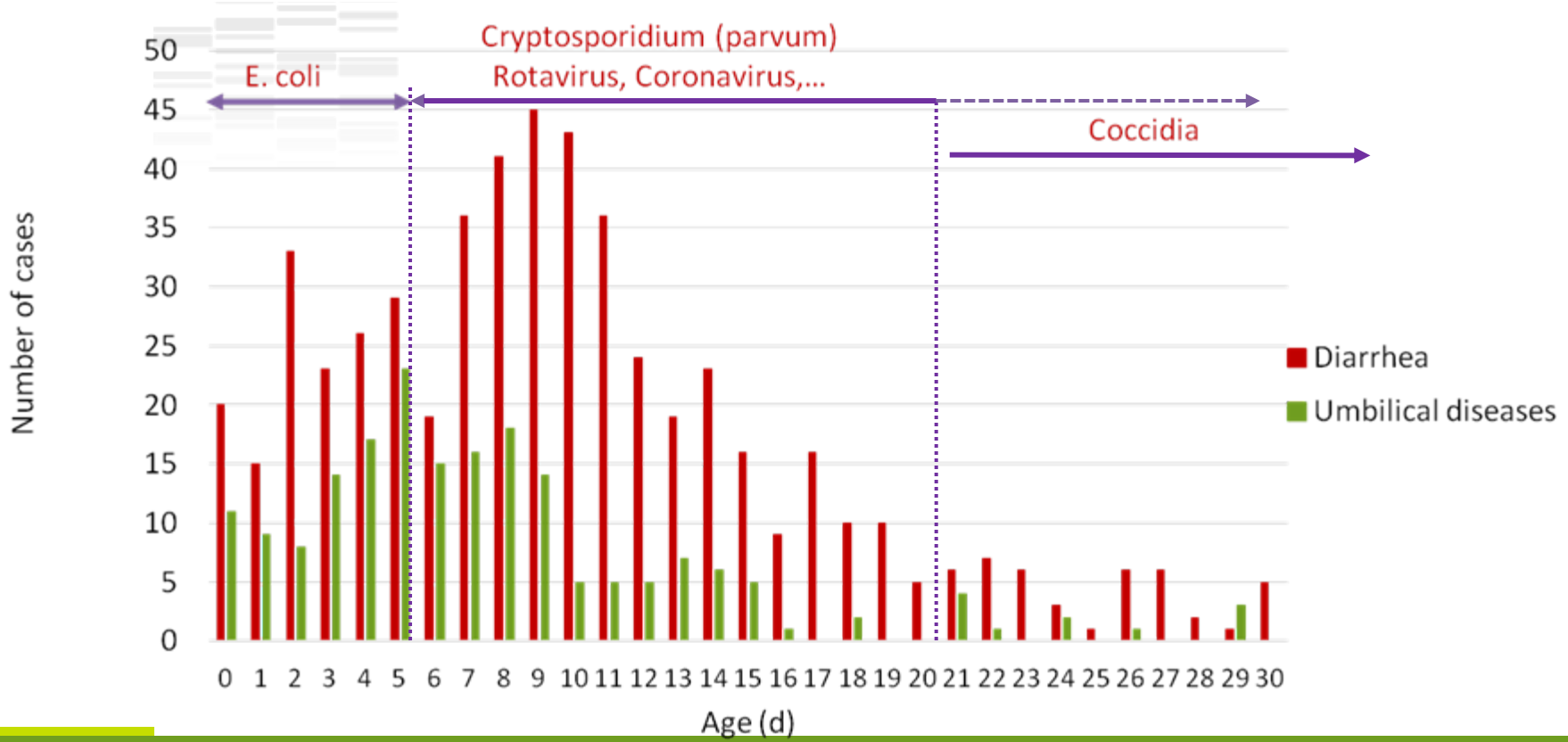
- Survival at 30 d (**Surv**) was defined as a binary trait (0 = dead; 1 = alive)

- Neonatal vitality (**NV**) was scored during the first 4 hours after birth:
  - 1: very vigorous (calf standing, walking & reaching the udder within the 1st hour)
  - 2: vigorous (calf reaching the udder within 1 and 3 hours of birth)
  - 3: weak (calf needing more than 4 hours to reach the udder)
  - 4: assisted (calf who requires help to stand and reach the udder)

- Umbilical infection occurring between:
  - 0 and 5 d of age (**Umb1**)
  - 6 and 20 d of age (**Umb2**)

- Diarrhea occurring between:
  - 0 and 5 d of age (**Diar1**)
  - 6 and 20 d of age (**Diar2**)

Distribution of calf age at the onset of disease events



Material and Methods – Statistical model

BLUP animal multi-trait linear model of calf health traits
accounting for maternal genetic and maternal common environmental effects:

$$\boldsymbol{y = Xb + Zu + Qm + Wc + e}$$

y: vector of observations for calf Surv, NV, Umb1, Umb2, Diar1, Diar2

b: vector of fixed effects: herd x year x season , dam age x parity, sex of the calf

u, **m**, **c**: vector of direct genetic, maternal genetic, maternal common environmental random effects with pedigree tracing back 3 generations (6,530 animals)

Univariate and multivariate analyses using ASREML (Gilmour et al., 1995)

Results – Univariate analyses

Trait	Mean	σ_p^2	h^2_d	h^2_m	c^2
Surv	96.3%	0.035 (0.001)	**0.023** (0.027)	**0.070** (0.042)	**0.088** (0.060)
NV	1.4 pt	0.292 (0.009)	**0.073** (0.035)	-	**0.168** (0.040)
Umb1	2.9%	0.027 (0.001)	**0.071** (0.038)	**0.017** (0.026)	-
Umb2	3.5%	0.032 (0.001)	-	**0.082** (0.029)	-
Diar1	5.3%	0.042 (0.001)	-	**0.044** (0.030)	**0.046** (0.048)
Diar2	11.7%	0.077 (0.002)	**0.016** (0.022)	**0.012** (0.026)	**0.100** (0.045)

Results – Phenotypic & Maternal common environmental correlations

Trait	Surv	NV	Umb1	Umb2	Diar1	Diar2
Surv		-0.06	0.03	0.02	-0.06	0.02
NV	0.05		0	-0.04	0.03	-0.04
Umb1	-	-		**0.11**	0.01	0.01
Umb2	-	-	-		0	0.02
Diar1	**-0.85**	**0.69**	-	-		**0.11**
Diar2	0.03	0.05	-	-	**0.999**	

Results – Direct & Maternal genetic correlations

Trait	Surv	NV	Umb1	Umb2	Diar1	Diar2
Surv		-0.53 (0.56)	-0.32 (0.52)	-	-	-0.71 (1.01)
NV	-		0.27 (0.33)	-	-	0.999 (ne)
Umb1	0.52 (0.50)	-		-	-	-0.07 (0.61)
Umb2	0.34 (0.27)	-	-0.68 (0.87)		-	-
Diar1	0.48 (0.39)	-	0.49 (0.78)	**-0.68** (0.32)		-
Diar2	0.59 (0.53)	-	-0.999 (ne)	**-0.85** (0.49)	0.33 (0.52)	

Conclusion

❖ These first results will have to be strengthened by large scale studies with several tens of thousands of phenotyped calves.

❖ Significant genetic variability is revealed in neonatal vitality, survival and umbilical infection.

❖ Maternal genetic effects may be more important than direct genetic effects in order to improve survival and resistance to early diarrhea or late umbilical infection

❖ Not all health traits can easily be improved simultaneously

→ Charolais breeders are now faced with the major task of prioritizing breeding objectives.

→ Indirect selection through the use of correlated traits such as calf survival or neonatal vitality may be an efficient mean to select for overall calf health performance.


Thank you for your attention