

INRAE

**Genetic analysis of colostrum
➤ and passive immune transfer in
divergent goat lines selected for
functional longevity**

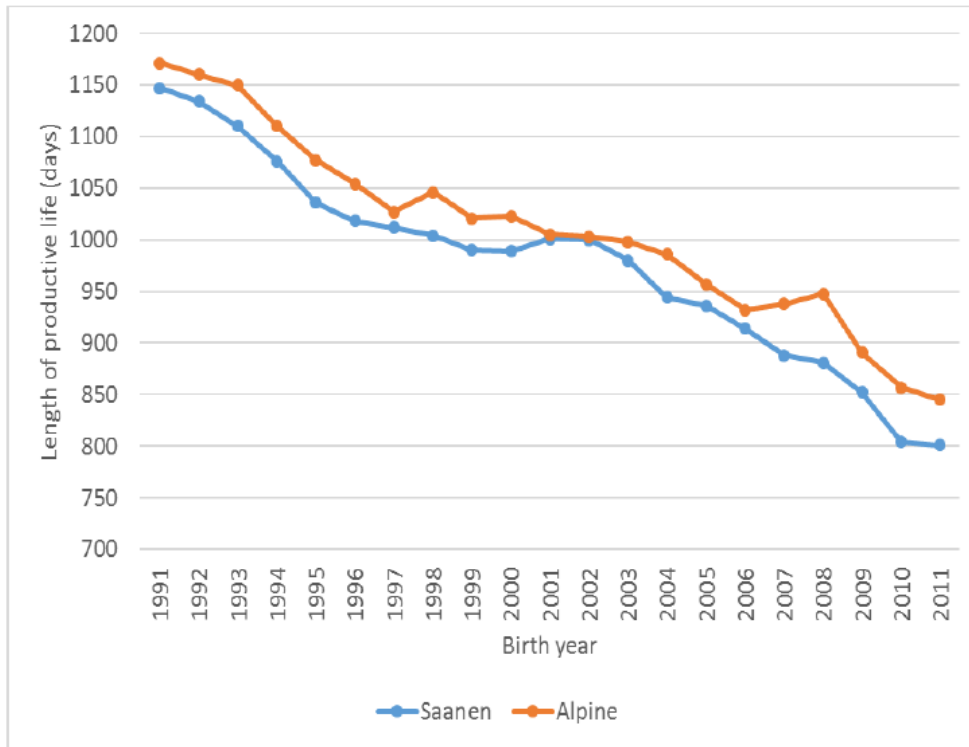
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Context



Evolution of the length of productive life in Alpine and Saanen breeds from 1991 to 2011 (Palhière, 2018)

LPL = number of days between first kidding and reform

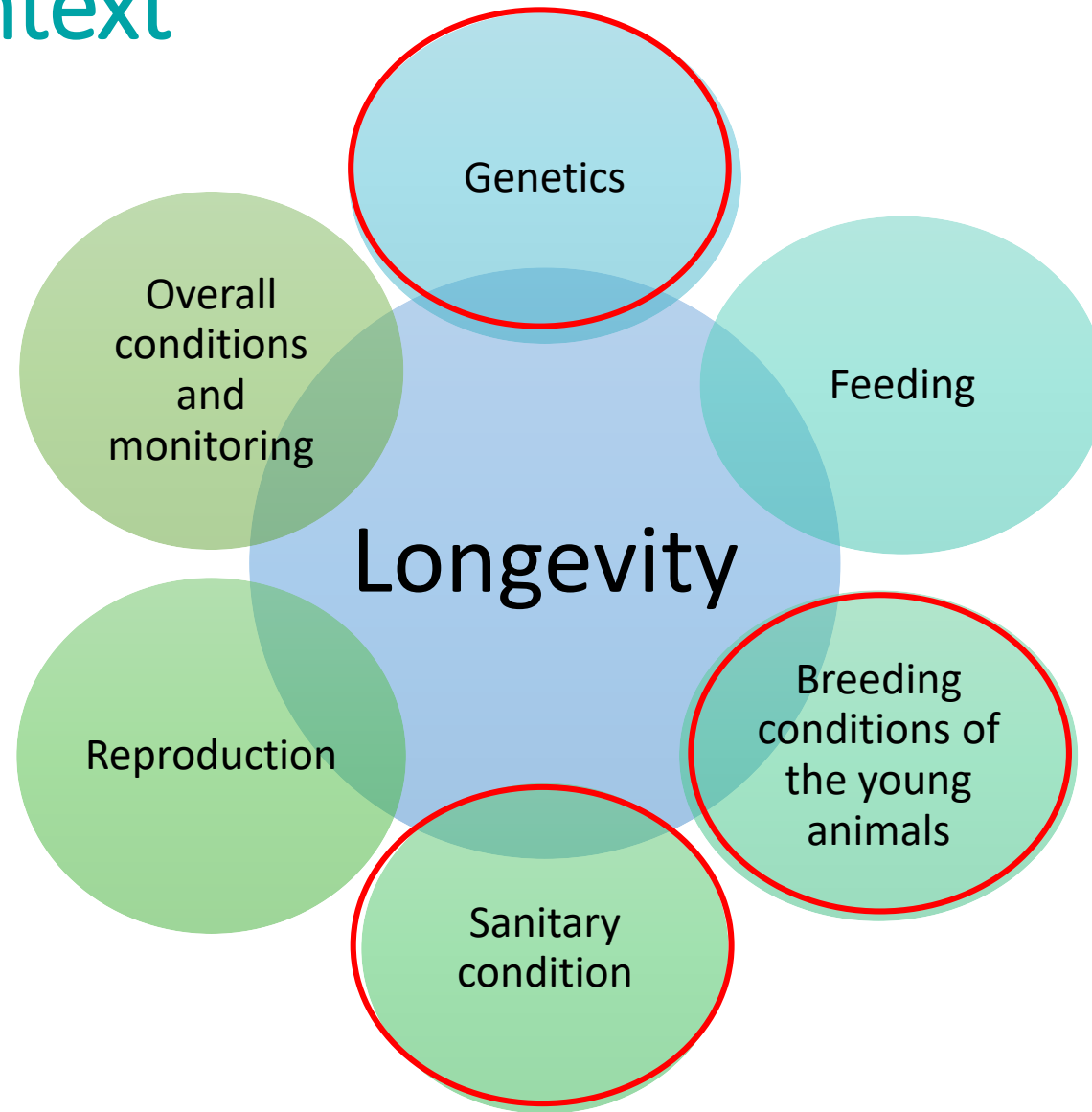
-320 days in 20 years

- production level

Functional longevity

→ Divergent lines from Bourges experimental unit

Context



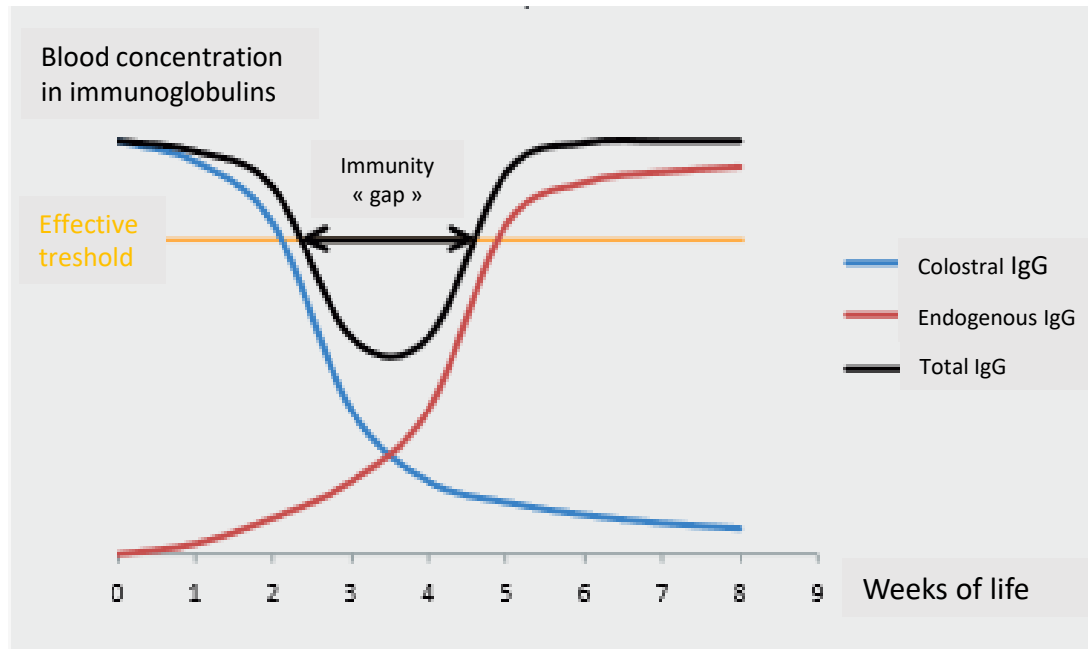
➤ Context

- **14% juvenile mortality rate** (up to 60% in intensive farming)
- Unproductive period
- **PIT (Passive Immune Transfer)** : transfer of antibodies from mother to kid (≠ active immunity)

→ **Success of PIT**: [IgG] in kids serum > 10g/L (1-5 days old)

- **Ingestion of quality colostrum in sufficient quantity**
- **Efficient absorption of immunoglobulins by kids**

Context



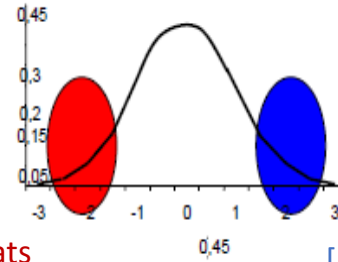
Schematic representation of blood antibody concentrations during the first weeks of life of goat kids (Omacap, 2015)

➤ Objectives

1. Study of the factors of variation of the colostrum quality and PIT within the divergent lines and their impact on the kids health
2. Quantify the genetic variability of colostrum quality and PIT → estimation of genetics parameters

Creation of divergent lines

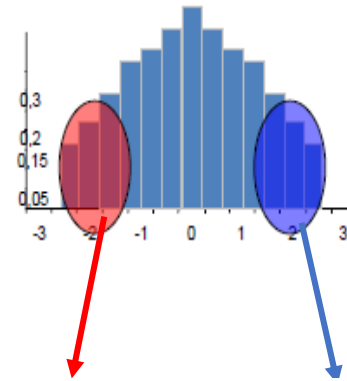
Population of AI males tested on progeny



[5-7] AI goats

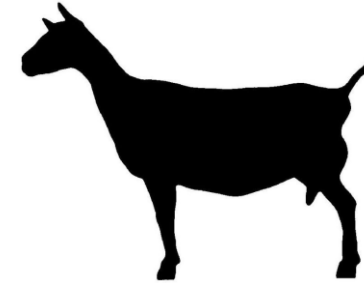
[5-7] AI goats

INRA Experimental unit
Alpine (Galles, Bourges)



Year of Birth	LGV-	LGV+
2017	43	38
2018	46	43
2019	37	44
2020	36	62
2021	37	27
Total	199	214

Measures



Birth

- Birth weight
- Vigor
- Litter size
- Modality of birth
- Colostrum ingestion time
- Time birth/ first colostrum intake
- **Serum IgG measurement** between 1 and 8 days

Birth - Weaning

- Health measures 1x /week
- **Genotyping** around 3 months old (blood sampling)

Kidding

- Colostrum weight
- **Colostral IgG measurements** (Radial Immunodiffusion)
- Colostral IgG measurement (%Brix)
- Pool number

Colostrum quality variability

→ 309 observations (repeated data)

→ Analysis of variance : Anova with R

→ Fixed effects linear model



Trait	ln([IgG]c)	ln(IgGy)	ln(CW)
Genetic line	0.16	0.27	0.60
Year	<0.05	0.23	<0.05
Litter Size	0.24	<0.0001	<0.01
Lactation rank	0.98	<0.01	<0.01

[IgG]c Immunoglobulin G concentration in colostrum

[IgG]y Immunoglobulin G yield in colostrum

CW Colostrum weight

➤ Variability of PIT

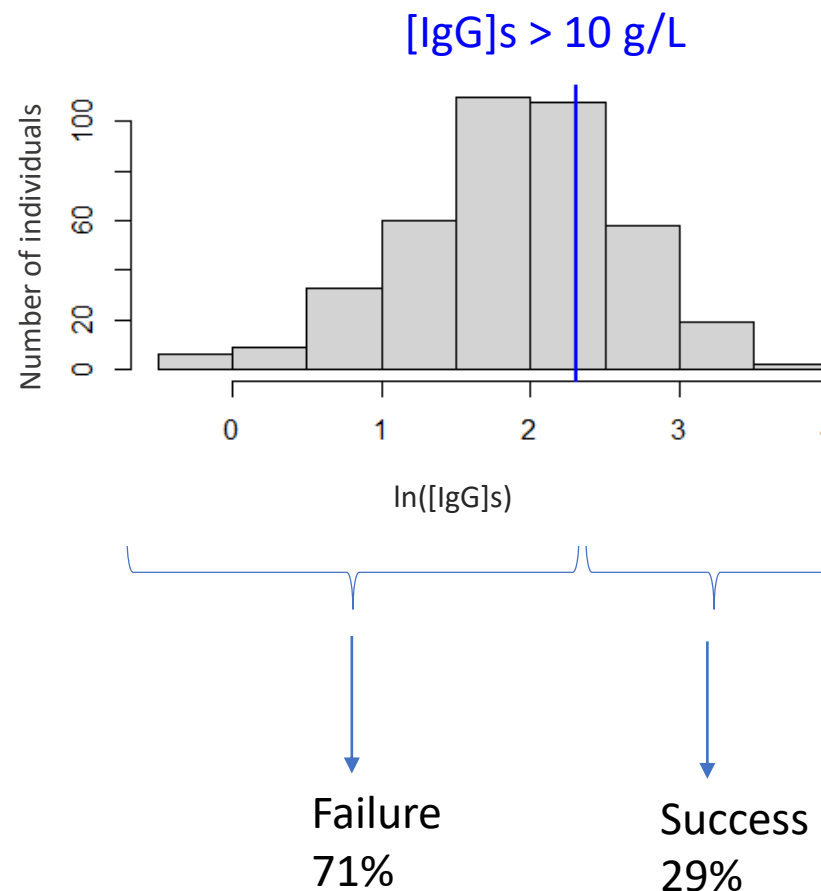
➔ 422 observations (repeated data)

➔ Analysis of variance : Anova with R

➔ Fixed effects linear model

	$\ln([\text{IgG}]s)$
Genetic line	0.10
Year of birth	$<10^{e-7}$
Birth weight	0.19
Age at blood sampling	0.11
Taille de portée	0.76
Birth vigor	0.28
Colostrum intake time	0.26

[IgG]s Immunoglobulin G concentration in serum



➤ Effect of PIT on health status



- Hindquarters cleanliness score(1/2/3)
- Diarrheas (0/1)
- Obstructed breathing (0/1)
- Nasal discharge (0/1)
- Ocular discharge (0/1)
- Abnormal body temperature (0/1) ($37,5^{\circ}\text{C} < \text{normal temperature} < 40^{\circ}\text{C}$)

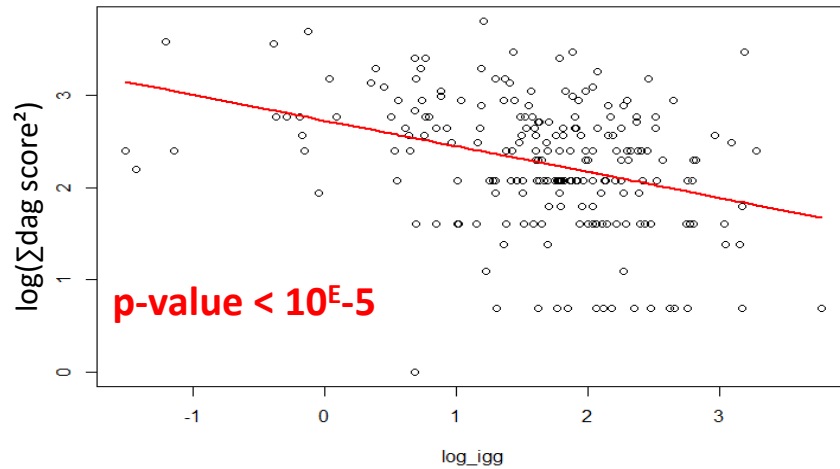
Logistic
regression

Would a better Passive Immune Transfer decrease the intensity and duration of the immunity gap ?

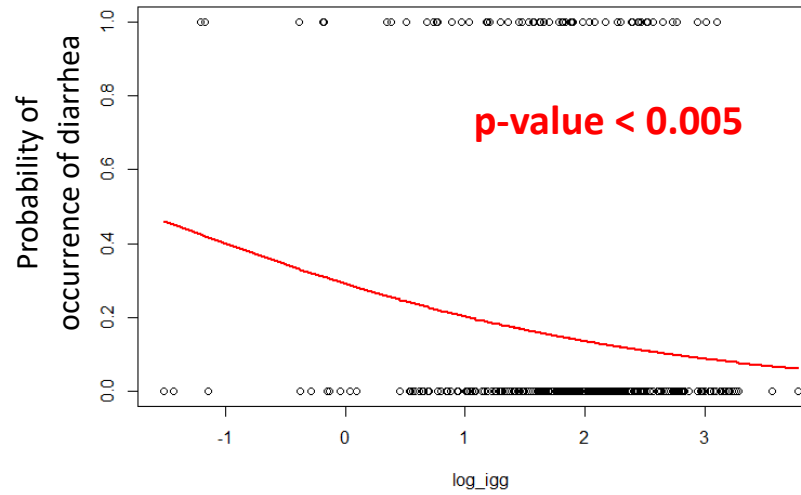
Health status



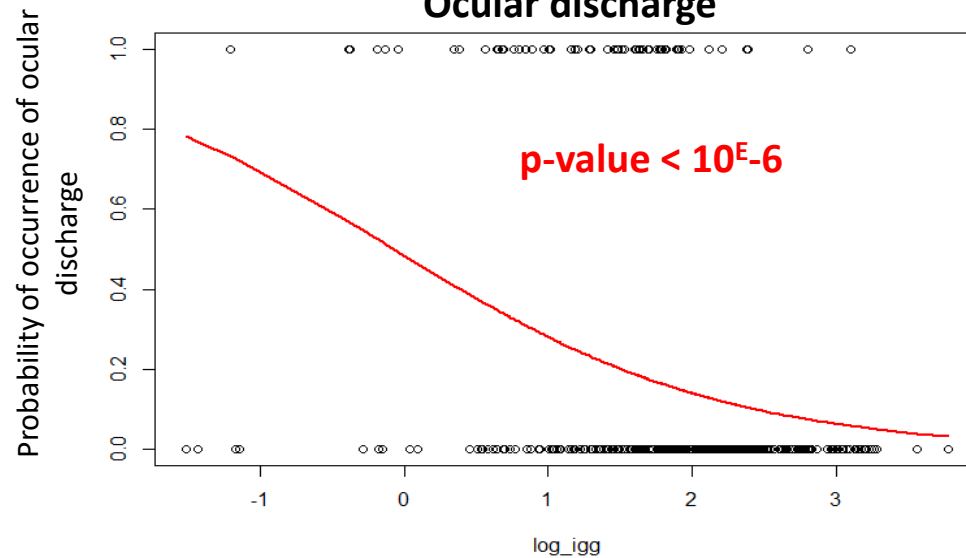
Hindquarters cleanliness score



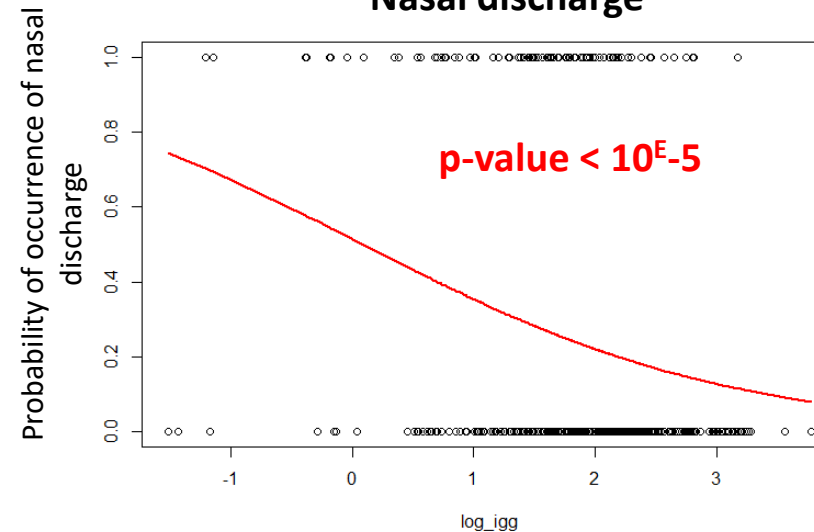
Diarrheas



Ocular discharge



Nasal discharge



Estimation of genetic parameters

- WOMBAT software
- Mixed model



ln([IgG]s) : $h^2=0.04 \pm 0.07$ (N=422)

	ln([IgG]c)	ln(IgG yield)	Milk Yield	FC/PC	LSCS
ln([IgG]c)	0.19 ± 0.16	0.73 ± 0.39	-0.15 ± 0.49	-0.03 ± 0.66	0.58 ± 0.93
ln(IgG yield)		0.37 ± 0.16	0.36 ± 0.31	-0.05 ± 0.51	0.53 ± 0.43
Milk Yield			0.44 ± 0.2	0,42 ± 0.45	0.11 ± 0.6
FC/PC				0,19 ± 0.16	*
LSCS				*	0.13 ± 0.15



N=201



➤ Estimation of genetic parameters

- **[IgG]c** : h^2 close to those observed in sheep and cattle \sim **0.10-0.20** (Gilbert et al., 1988, Soufleri et al., 2019, Martin et al. 2021, Conneely et al., 2013)
- **Dairy traits**: h^2 coherent
- **High genetic correlations between colostrum traits and LSCS**
- **[IgG]s** : h^2 lower than that observed in sheep \sim **0.18** (Gilbert et al., 1988) and non significantly different than that observed in cattle \sim **0.06** (Haagen et al., 2020) or \sim **0.02** (Donovan et al., 1986)

➤ Conclusion and perspectives

- No genetic line effect noted on these traits
- Standard errors → **larger data?** Permanent environmental effect ?
- **Possible selection for colostrum traits** ([IgG]c and IgG Yield)
- **Promising reliability of %Brix** for future phenotyping
- **Uncertain selection for PIT**
 - colostrum of the mother, individual colostrum, presence of the mother





**Thank you for your attention and to
the experimental unit of Bourges**



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Activegoat
WCGALP 2022 / M Wicki

