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Residual feed intake divergent selection in sheep

Francois[1], D., Bouvier[2], F., Ricard, E[1]., Bourdillon[2], Y., Weisbecker[1], J.L., Marcon[2], D.

[1]INRA, UR 631 SAGA, BP 52627, Borde Rouge, 31326 Castanet-Tolosan, France
[2]INRA, UE 332 Domaine de la Sapinière, Unité Expérimentale Ovine, 18390 Osmoy, France

Dominique.Francois@toulouse.inra.fr

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Meat sheep selection background

- Lamb Production costs (fixed costs excluded) :
  - Feeding costs = 80%
- Current selection schemes:
  - Growth and carcass traits
    - ADG ; Reducing carcass fat ; Muscular Development
      - Indirect responses on feed efficiency
  - Maternal abilities : reproduction (prolificacy) and milk ability (growth of suckling lambs)
  - Disease Resistance (scrapie)

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Feed intake

One way to improve lamb production may be to increase the efficiency of feed transformation by lambs

Measurement of feed intake in sheep has been performed with automatic feeders on young rams as they are submitted to individual test for selection on liveweight (LW), growth and body composition

The test is following a national scheme process and lasts 8 weeks from about 100 to 156 days of age

LW and ultrasound scan (US) are recorded at start (LW only), mid (both LW and US) and end (both LW and US) of the test

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Feed intake Measurement : group-reared candidates for selection

- 3 year-long device development (90's):
  by evolution of an automatic feeder used in pig selection centres
  - Measurement of quantity of pellets in the trough (gram precise)
  - Dates (Day,hour, minute,second) of entrance and going out
  - Use of electronic ear tags
  - Pneumatic commands to reduce noise
  - Adjustment of the group size to 20-25
  - Adaptation protocol: 2 weeks
  - Control protocol : 8 weeks, 56d
- 8 feeders, 160 animals by batch

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Group of 20 young rams fed with an automatic feeder
(INRA-Bourges la Sapinière)

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Results: feeding traits + related traits (7 batches)

Variable	Description	N	Mean	Std deviation
DFI	Daily Feed intake during 8 weeks (aged from 85 to 140 days)	752	1794 g	242 g
RFI	Residual feed intake = adjusted for Weight at mid test, ADG, backfat and muscle depth	739	0	117 g
FE	Feed efficiency ADG/DFI adjusted for Weight at start	734	19.3 %	2.0 %
ADG	Average daily gain for 56 days	981	339 g	52 g
W mid	Weight at mid test	981	47.2 kg	5.4 kg

Estimates of genetic parameters : gross traits

Traits	DFI	ADG	Backfat	Muscle	W mid
DFI	**0.43**	0.83	0.31	0.32	0.85
ADG		**0.43**	0.17	0.31	0.74
Backfat			**0.46**	0.26	0.18
Muscle				**0.36**	0.33
W mid					**0.36**

(François *et al*, 7WCGALP, 2002)

Estimates of genetic parameters: adjusted traits

Traits	RFI	ADG	Backfat 50kg	Muscle 50kg	FE
RFI	**0.30** **0.06**	0	-0.05	0	-0.63
ADG		**0.43** **0.05**	-0.33	-0.13	0.74
Backfat50kg			**0.37** **0.06**	0.15	-0.42
Muscle50kg				**0.23**	-0.12
Feed Effic.					**0.36**

(FE=feed efficiency= ADG/DFI=1/FCR for 'feed conversion ratio')

(François *et al*, 7WCGALP, 2002)

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Diets

First step results : pellet + hay (not measured)
Energy in this pellet was
2.48 Mcal Metabolizable Energy / kg Dry Matter.

Second step results: diet without hay, less concentrated pellet:
Energy was 2.27 Mcal Metabolizable Energy / kg Dry Matter,

while Cellulose Rate was 3 % higher than in diet 1 (12 % vs 9 %).

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Demonstration experiment : divergent selection for RFI

Selection of 2 groups of 10 sires among a batch of 160, groups extremes for RFI

liveweight, growth and body composition means were equivalent between the 2 groups

2x7 had progeny
160 male offsprings have been phenotyped

--> Estimation of realised h^2

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Selected lots	*Positive RFI (unfavorable)*	*Negative RFI (favorable)*	*Gap (fav-unfav)*
Mean DFI of sires (g/j)	*2031*	*1652*	*- 379*
Mean RFI of sires (g/j)	*+ 204*	*- 211*	*- 415*

415 g selection differential = 3.7 residual standard deviation

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Selected lots	*Positive RFI (unfavorable)*	*Negative RFI (favorable)*	*Gap (fav-unfav)*
Mean DFI of sires (g/j)	*2031*	*1652*	*- 379*
Mean RFI of sires (g/j)	*+ 204*	*- 211*	*- 415*
Number of offsprings	67	82	
Mean DFI of offsprings (g/j)	*1741*	*1664*	*- 77*
Mean RFI of offsprings (g/j)	*+ 26*	*- 21*	*- 47*

Realised $h^2 = ((2 \times 47) / 415) = 0.23$

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Correlated responses on liveweight, growth and FCR

Selected lots	*Positive RFI (unfavorable)*	*Negative RFI (favorable)*	*Gap (fav-unfav)*	SD	Gap in SD unit
ADG (g)	355	377	- 22	50	- 0.44
Liveweight at start (kg)	33.3	32.1	+ 1.2	5.4	0.22
Liveweight at mid-test (kg)	44.2	43.6	+ 0.6	5.9	0.10
Liveweight at end (kg)	53.2	53.3	- 0.1	6.4	- 0.02
Liveweight adjusted at 140 d(kg)	50.9	51.0	- 0.1	6.2	- 0.02
Feed conversion ratio (DFI/ADG)	4.72	4.66	+ 0.06	0.60	0.10

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Correlated responses on body composition

Selected lots	*Positive RFI (unfavorable)*	*Negative RFI (favorable)*	*Gap (fav-unfav)*	SD	Gap in SD unit
US backfat at mid test (mm)	6.8	6.4	+ 0.4	0.8	0.50
US backfat at end test (mm)	7.4	7.1	+ 0.3	0.9	0.33
US muscle at mid test (mm)	22.8	22.7	+ 0.1	1.9	0.05
US muscle at end test (mm)	23.9	24.0	- 0.1	1.8	0.06

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Conclusions

- Consistent response on the trait (RFI)
- Low correlated responses on LW, muscle and FCR
- Higher correlated responses for ADG and backfat, one generation divergent selection: could be side effects
- Very low genetic correlations between RFI and ADG & Backfat estimated with larger numbers

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Perspectives

- For schemes with growth and body composition breeding goals
- Lacaune GEBRO strain:
  - 6 feeders
  - 600 rams phenotyped
  - Trait being soon included in the genetic scheme
- Other terminal breeds growing interest
- To be linked with sheep industry (profit/invest)

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Thank you for listening

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