



SMALL RuminanTs breeding for Efficiency and Resilience

Task 2.3 – Behavioural adaptation traits

Task leader: **AUTH**

Involved partners: **INRAE, SRUC, TEAGASC, INIA-UY**

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INRAE



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➤ Objectives

1. Monitor key behavioural adaptation traits in extensive and intensive farming systems utilising new technologies
2. Estimate phenotypic and genetic parameters for indicators of behavioural adaptation

➤ Studies

1. GPS generated phenotypes for behavioural adaptations to extensive grazing systems (**AUTH**)
2. Relationship between efficiency and behavioural adaptation (**INRAE**)
3. Behavioural reactivity at weaning and maternal reactivity at lambing (**INRAE**)
4. Ewe and lamb behaviours - lamb neonatal vigour & ewe mothering ability (**SRUC & TEAGASC**)
5. Resilience indicators – maternal performance (**SRUC & TEAGASC**)
6. Lamb temperament (**INIA-UY**)

➤ GPS-generated phenotypes for behavioural adaptations to extensive grazing systems

- Objective:**
- To investigate the **grazing behaviour** of Boutsko sheep reared in semi-extensive conditions **in mountainous regions** using **GPS devices**
 - To estimate **phenotypic and genetic parameters** for key **grazing behaviour** traits



Animal resources: 300 Boutsko dairy sheep from 3 semi-extensive farms – monitored with GPS devices

- Key results:**
- Grazing behaviour of Boutsko sheep is characterised by high duration, distance and speed
 - Significant heritability for grazing duration (0.75) and speed (0.78)
 - Significant repeatability for grazing duration (0.85), speed (0.86), elevation gain (0.14), energy expenditure (0.14)
 - Practices for higher grazing duration are expected to decrease speed (-0.99) and increase distance (0.28)

- Novelty:**
- First study to estimate phenotypic and genetic parameters for grazing behaviour traits of sheep
 - Potential for appropriate breeding programmes and management practices to improve sheep grazing behaviour and adaptation to extensive rearing conditions

- Recommendations for EU:**
- **GPS devices** can be used to efficiently **monitor the grazing behaviour** of sheep
 - Selection practices to improve **adaptation to extensive rearing** conditions – Breeding programmes for **higher grazing duration and distance**

➤ Efficiency and behavioural adaptation



Objective: To investigate the roles of **genetic lineage** (feed efficiency, RFI) and **early rearing mode** (artificial indoors vs. maternal outdoors) on **behavioural and metabolic adaptation in lambs** to rangeland conditions

Animal resources: 80 Romane ewe lambs (INRAE experimental farm), studied from birth to first lambing (2 years)

- Key results:**
- No effect of genetic line on behavioural adaptation (time budget, reactivity and risk-taking tests)
 - Greater mobilization of body reserves in low efficient lambs during the 1st month on the rangeland
 - Transitory difficulty to adapt to rangeland for artificially reared lambs (behavior, metabolism, growth; not mixed with experienced maternally reared lambs), with persistent difference in BW
 - Long-term greater proximity to humans and lower emotional reactivity for artificially reared lambs

- Novelty:**
- Sheep from indoors divergent selection on feed efficiency (with concentrate diets) reared in rangeland conditions
 - Longitudinal phenotyping (behaviour, performance, metabolism, microbiota, welfare, health) of sheep from contrasted and common rearing practices
 - Effects of early experience have faded relatively quickly even in the absence of animals mixing

Recommendations for EU: Sheep from artificial rearing can adapt to extensive conditions but care should be taken on **transition period** (transitory complementation, social model...)

TASK 2.3: Behavioural adaptation traits - INRAE



➤ Behavioural reactivity at weaning and maternal reactivity at lambing

Objective: To investigate genetic parameters and efficiency of genetic selection for behavioural traits

Animal resources: 1,080 Romane lambs and 620 Romane ewes (INRAE experimental farm),
(and background data)



Key results:

- Sociability towards conspecifics and docility towards an approaching human are heritable ($h^2= 0.5$ and 0.2 , respectively)
- Maternal reactivity at lambing is heritable ($h^2= 0.10$ to 0.45 , depending on the trait)
- High genetic correlation between sociability at weaning and maternal reactivity at lambing
- Divergent genetic selection for sociability and docility was efficient (high vs low: $1,8 \sigma_g$ and $1,0 \sigma_g$, resp.)

Novelty:

- High genetic component for several behavioural traits in sheep
- Early (at weaning) genetic selection on behaviours is feasible in sheep
- Genetic selection for sociability may improve maternal behavior at lambing

Recommendations for EU: Early genetic selection for behavioural traits could be used to improve adult behaviour in sheep and contribute to increase adaptation, welfare and performances in challenging environments

➤ Ewe and lamb behaviours

Objective: To estimate parameters for **lamb neonatal vigour and ewe mothering ability** (*lamb survival, lambing ease previously*)

Animal resources: 4.7K-17.3K ewes and up to 54.3K lambs [from 139 commercial flocks in Ireland]

Key results:

- Direct heritability for lamb vigour = 12%; Mothering ability = 7%
- Significant between-sire variation for poor mothering ability of female offspring
- Little evidence of between-breed differences
- Good mothers have lower lamb mortality. Ewes of higher litter size have higher mothering ability
- Heavier lambs have higher (better) lamb vigour scores (and low lamb mortality)

Novelty:

- Results give a good overview and further insight about relationships amongst key traits at lambing
- New 5-point scores for ewe and lamb behaviours can be done quite easily in commercial flocks
- Irish breeding programme has incorporated Survivability, lambing ease, lamb vigour and ewe mothering ability in maternal sheep index for national evaluations

Recommendations for EU: Genetic selection for key behavioural traits at lambing increases flock efficiency by reducing lamb mortality. It enables the identification of poor sires for maternal ability to inform selection for future generations.

➤ Resilience indicators – maternal performance

Objective: To estimate parameters for **new indicators of new maternal traits** with **performance indicators**

Animal resources: Dorset, Lley, Texel [National data **UK** 73.7K from 51 flocks; 75.8K from 160 flocks; 63.4K from 133 flocks, respectively)



- Key results:**
- New trait definitions (Longevity – (time 1st-last lambing event), lambing interval, age at 1st lambing)
 - Low heritability (Longevity –11%; Lambing interval (days) 2-12%; Age at 1st lambing 16-31%)
 - Genetic links between productivity (no. lambs reared) and longevity
 - Higher litter size linked to longer lambing intervals and reduced longevity

- Novelty:**
- New insight into productive lifespan linked to performance – animals with higher lifetime litter size and shorter longevity in Dorset breed (r_g -0.4, r_p -0.2)
 - Less productive ewes last longer (r_g Longevity and lambing interval r_g 0.6; r_p 0.6)
 - “Live fast and die young” scenario – but correlations suggest improvements in both are possible

Recommendations for EU: Important to include broad set of breeding goals into sheep breeding programmes to prevent premature involuntary culling

TASK 2.3: Behavioural adaptation traits – INIA-UY

➤ Lamb temperament

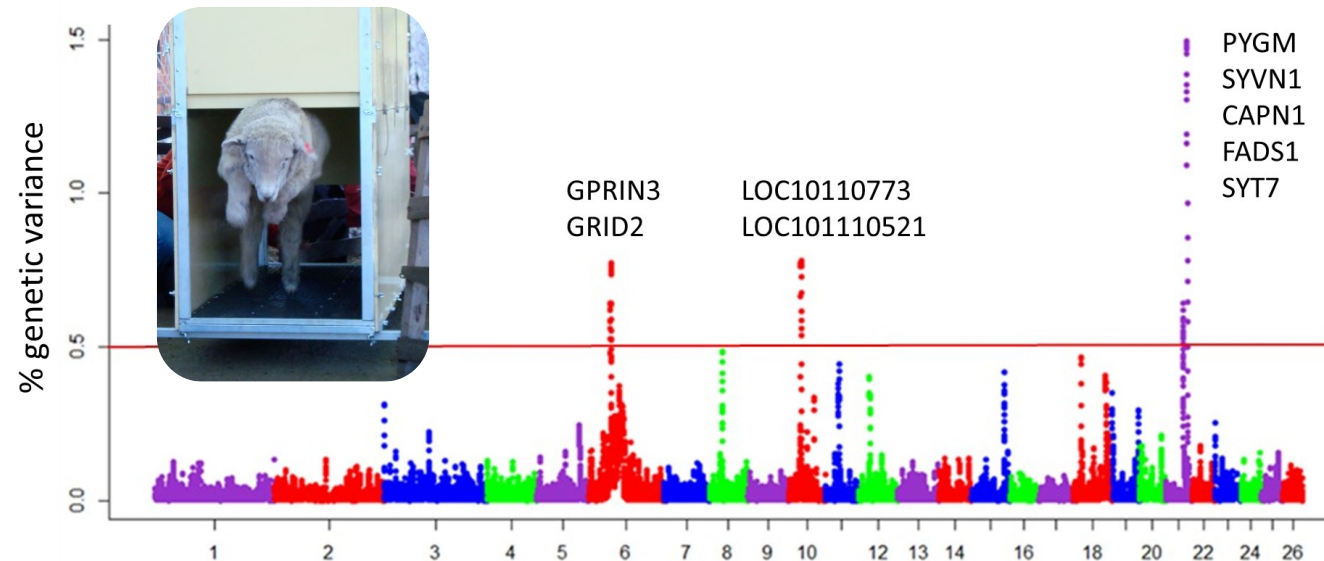
Objective: To search for QTL associated with behavioural traits

Animal resources: 4,317 records (lambs) 10,799 pedigree and 1,702 genotyped animals (GGP 50k)

Traits investigated: Temperament: Isolation Box Test in lambs (post-weaning)

Key results:

- Heritability 0.19 ± 0.04
- Three genomic regions explained the greatest % of the genetic variance, resulting in 25 SNP associated with nine candidate genes on chromosomes **6**, **10** and **21**.



Recommendations for EU

genetic variants in PYMG, CAPN1, GRID2, SYT7 gene could be used as molecular markers for future studies associated with temperament trait or behavioral associated to stress.

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Thank you for your attention

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