74th Annual Meeting of The European Federation of Animal Science
Lyon, France - August 26th to September 1st, 2023

Session 39: TechCare & ClearFarm projects Abstract #41661

Monitoring the stress of light goat kids transported over short journeys

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TECH CARE
Integrating innovative TECHnologies along the value Chain to improve small ruminant welfARE management

G2R Grup Recerca Remugants

Project funded by the H2020 research and innovation program of the European Union (Contract No 862050)

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Session 39: TechCare & ClearFarm projects Abstract #41727

Monitoring the stress of light suckling lambs transported over short journeys

Elhadi A., Jesús J.C., Costa R., Recio A., Salama A.A.K. and Caja G.

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Project funded by the H2020 research and innovation program of the European Union (Contract No 862050)

Introduction

Regulation EC1/2005: **Transport of long journeys** (8-14 h)

5.1.2005 EN Official Journal of the European Union L 3/1

COUNCIL REGULATION (EC) No 1/2005

of 22 December 2004

on the protection of animals during transport and related operations and amending Directives 64/432/EEC and 93/119/EC and Regulation (EC) No 1255/97

Specifications:

- Authorized vehicles.
- Trained drivers.
- Temperature: 5-30ºC (± 5ºC).
- Space: According to species, age, weight...

Missing in the Regulation:

- Short duration trips (< 8 h).
- Goat **kids** < 35 kg and **light lambs** < 20 kg during “Suckling period” (travelling > 3 Mhead/year in Spain).

Introduction

- Space allowances for sheep and goat transported by road (EC 1/2005)

Species	BW, kg	m^2/animal	m^2/kg
Sheep unshorn	> 55	> 0.4	> 0.007
	< 55	0.3-0.4	0.006-0.007
Shorn & lambs	> 26	0.2-0.3	0.008-0.012
Small lambs[1]	**< 20**	**> 0.2**	**> 0.010**
Goats	> 55	> 0.4-0.75	0.007-0.014
	35-55	0.3-0.4	0.007-0.009
	< 35	0.2-0.3	0.006-0.009
Small kids		**No data**	

[1]Older than 1 wk (unless transported < 100 km). *As an indication: for small lambs, an area of under 0.2 m^2 per animal may be provided"*.

Introduction

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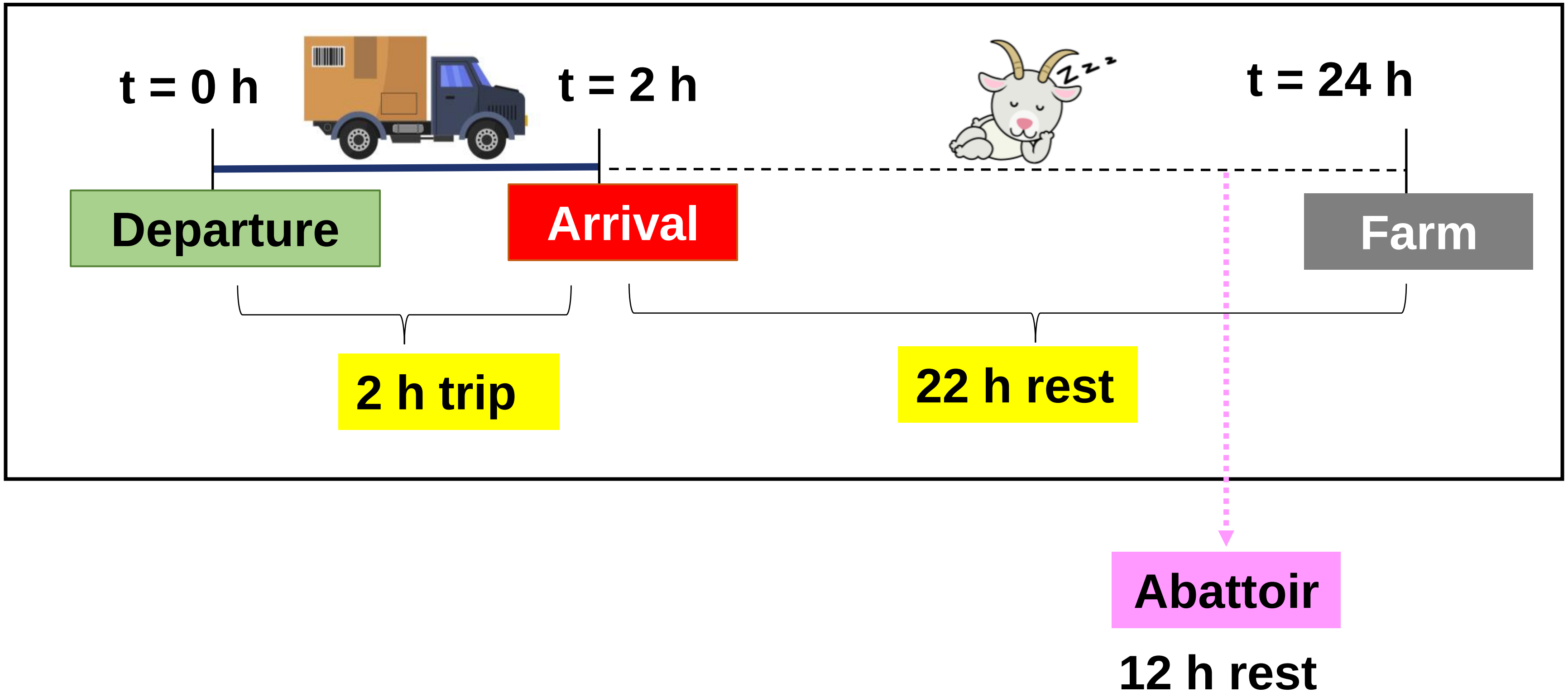
	35-55	0.3-0.4	0.007-0.009
	< 35	0.2-0.3	0.006-0.009
Small kids	**< 10**	**> 0.1?**	**> 0.010?**

[1]Older than 1 wk (unless transported < 100 km). *As an indication: for small lambs, an area of under 0.2 m^2 per animal may be provided"*.

Objective and design

- To evaluate the effect of **2 space densities (high vs. low)** of transportation for **suckling kids or lambs** over a short journey (2 h) by smooth roads.
- Design: **Before** - **After** - **Resting** (or slaughter in lambs)



Material & methods: Animals (1/2)

- Artificially reared kids at the UAB experimental farm

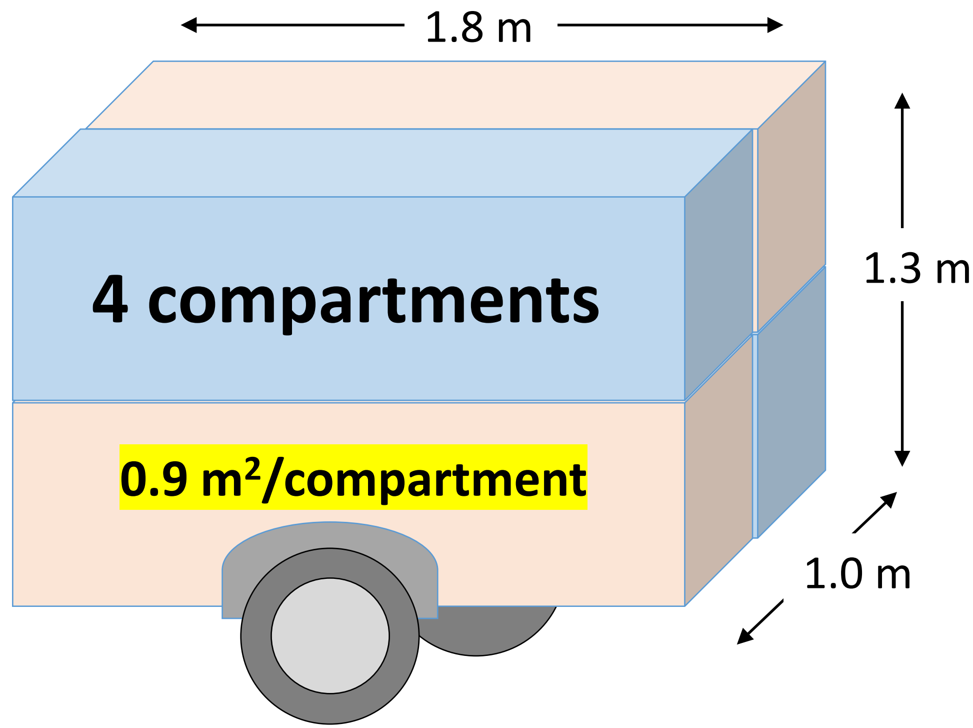
25 Murciano-Granadina kids: 10 males + 15 females

Material & methods: Animals (2/2)

- Artificially reared lambs at the UAB experimental farm

Material & methods: Transportation facility

- Animal transportation facility: Homologated trailer
- Diagonal allocation of treatments



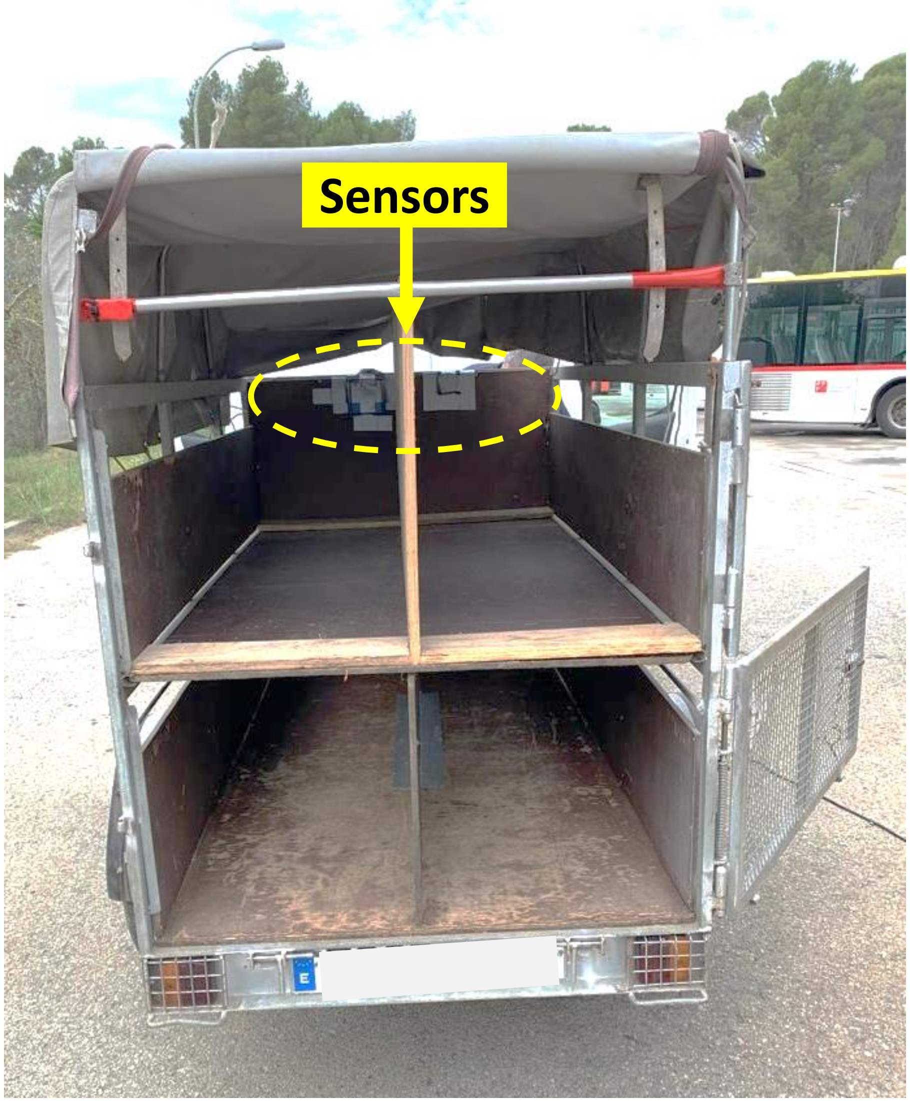
Reference (EC) 1/2005 = 0.2 m^2/lamb 20 kg = 0.010 m^2/kg (100%)

Material & methods: Sensors

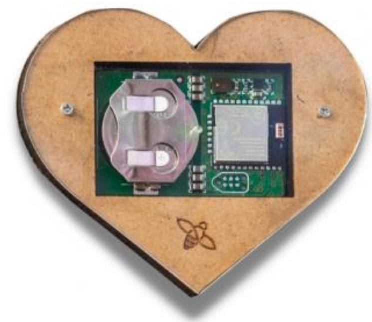
- Trailer sensors: 3A accelerometers, T-HR and Sound

Driver's cab
vs.
Trailer

2x Accelerometers of 3 axes



Data logger (T & RH)



Sound sensor

Material & methods: Experimental design (1/2)

- Transport densities for **kids** in the UAB's trailer

Density	High	Low
Kids, n	**15** (8♀ + 7♂)	**10** (5♀ + 5♂)
BW, kg	9.3 ± 0.5	9.8 ± 0.7
Space, m²/kg BW	**0.013**	**0.018**
Space, m²/animal	0.12 (100%)	0.18 (150%)

- Transport densities for **lambs** in the UAB's trailer

Density	Standard	Low
Lambs, n	**12** (6♀+ 6♂)	**8** (4♀ + 4♂)
BW, kg	13.8 ± 0.5	14.0 ± 0.3
Space, m²/kg	**0.011**	**0.016**
Space, m²/animal	0.15 (100%)	0.23 (153%)

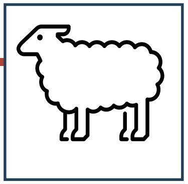
Material & methods: **kid's** trip description

- Road and trip description (November 16th, 2022)

Duration	**1 h 56 min**
Distance, km	122.6
Speed, km/h	63.4
Unevenness, m	575

Material & methods: **Lamb's** trip description

- Road and trip description (November 21st, 2022)



Duration	**2 h 13 min**
Distance, km	116.6
Speed, km/h	58.7
Unevenness, m	581

Material & methods: Measurements (1/2)

The variables measured **in vivo** were:

- Body weight
- Stress signs (by sight)
- Temperature:
  - Rectal (digital thermometer)
  - Iris & Lacrimal (IR thermometer)
- Metabolic indicators in serum:
  - Creatinine kinase (CK)
  - Lactate dehydrogenase (LDH)
  - Free fatty acids (FFA or NEFA)
  - Cortisol
  - Glucose
  - Urea

Material & methods: Measurements (2/2)

- **Manchega lambs:**
  - Electronically identified (e-ID) using injectable transponders (Datamars HDX, 12 mm; Bedano, SW) under the tail to trace the carcass in the abattoir.
  - Addressed to slaughter after 12 h of rest.
  - Carcasses assessed after 24 h at 4ºC (Colomer-Rocher & Espejo, 1971).



- **Lacaune lambs:** Addressed to replacement and weighed after a 24 h of rest.

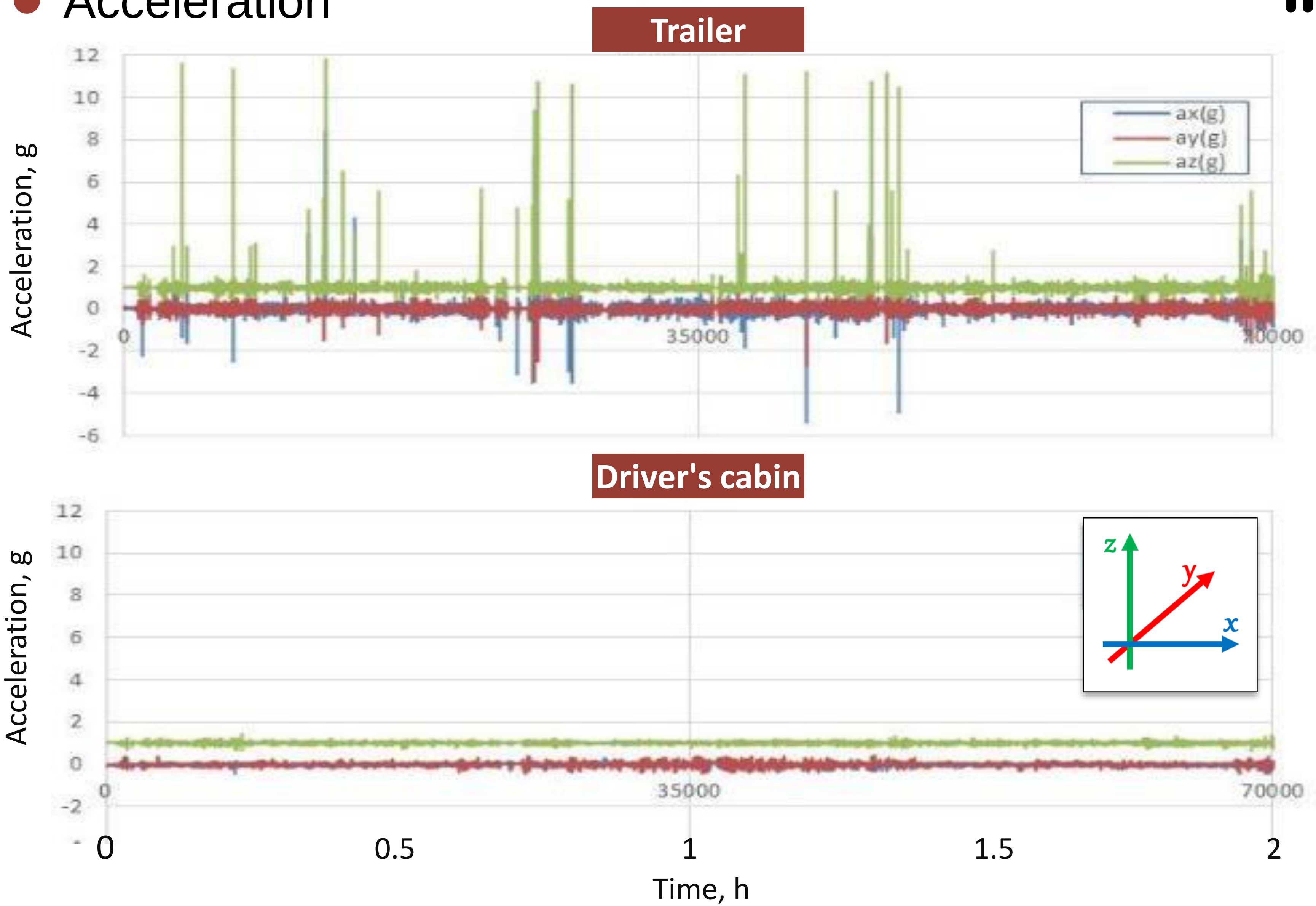
Material & methods: Statistical analyses

- Normality of variables tested by using Shapiro-Wilk and transformed by Johnson Transformation.
- **Proc Mixed** (SAS Inst. v.9.4) for repeated measurements. The Model contained:
  - Fixed effects: transport density, time, sex and interactions.
  - Random effects: animals and error.

  Differences between means by using PDIFF (P < 0.05).

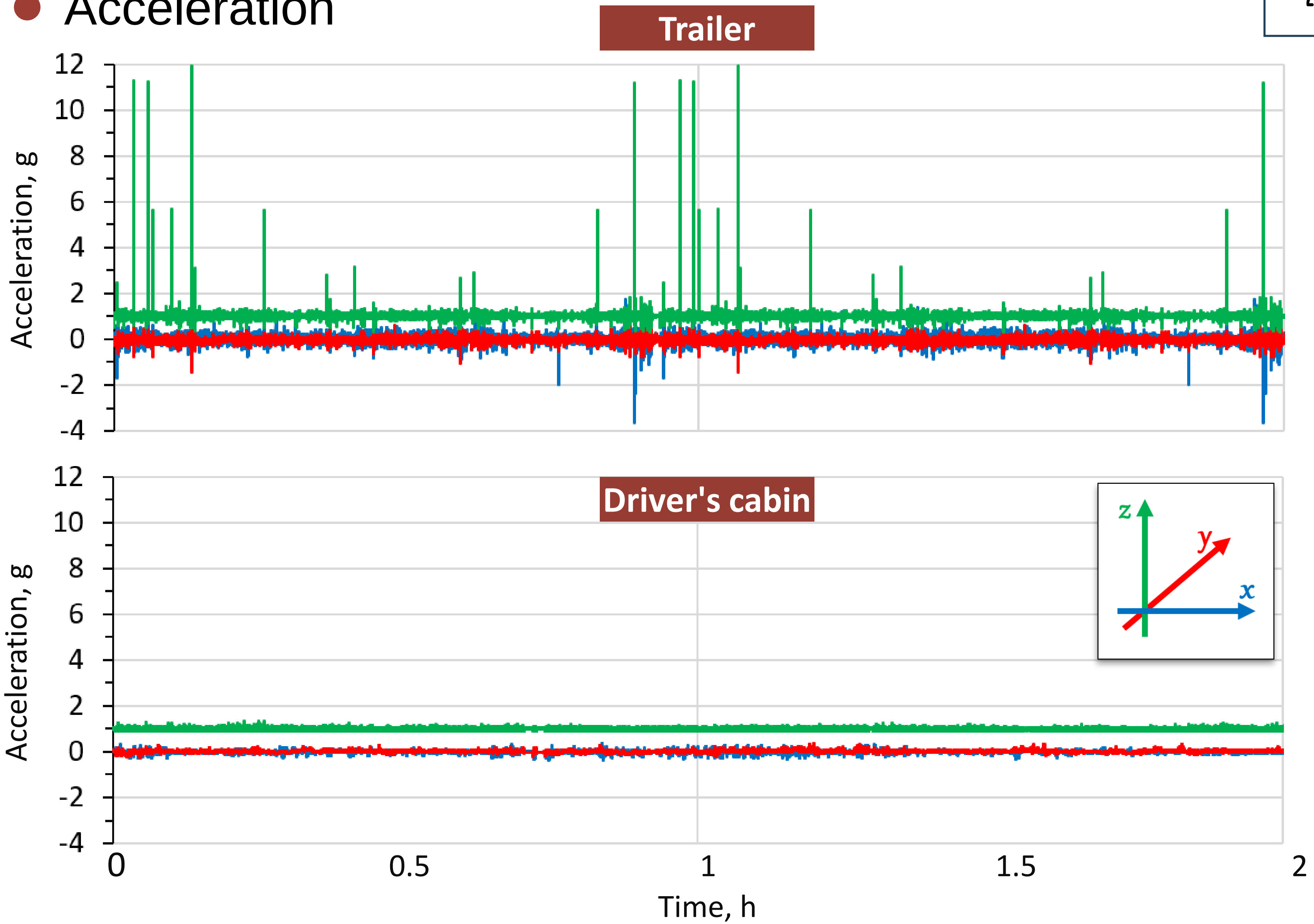
Results: Transport conditions in **kids**

- Acceleration



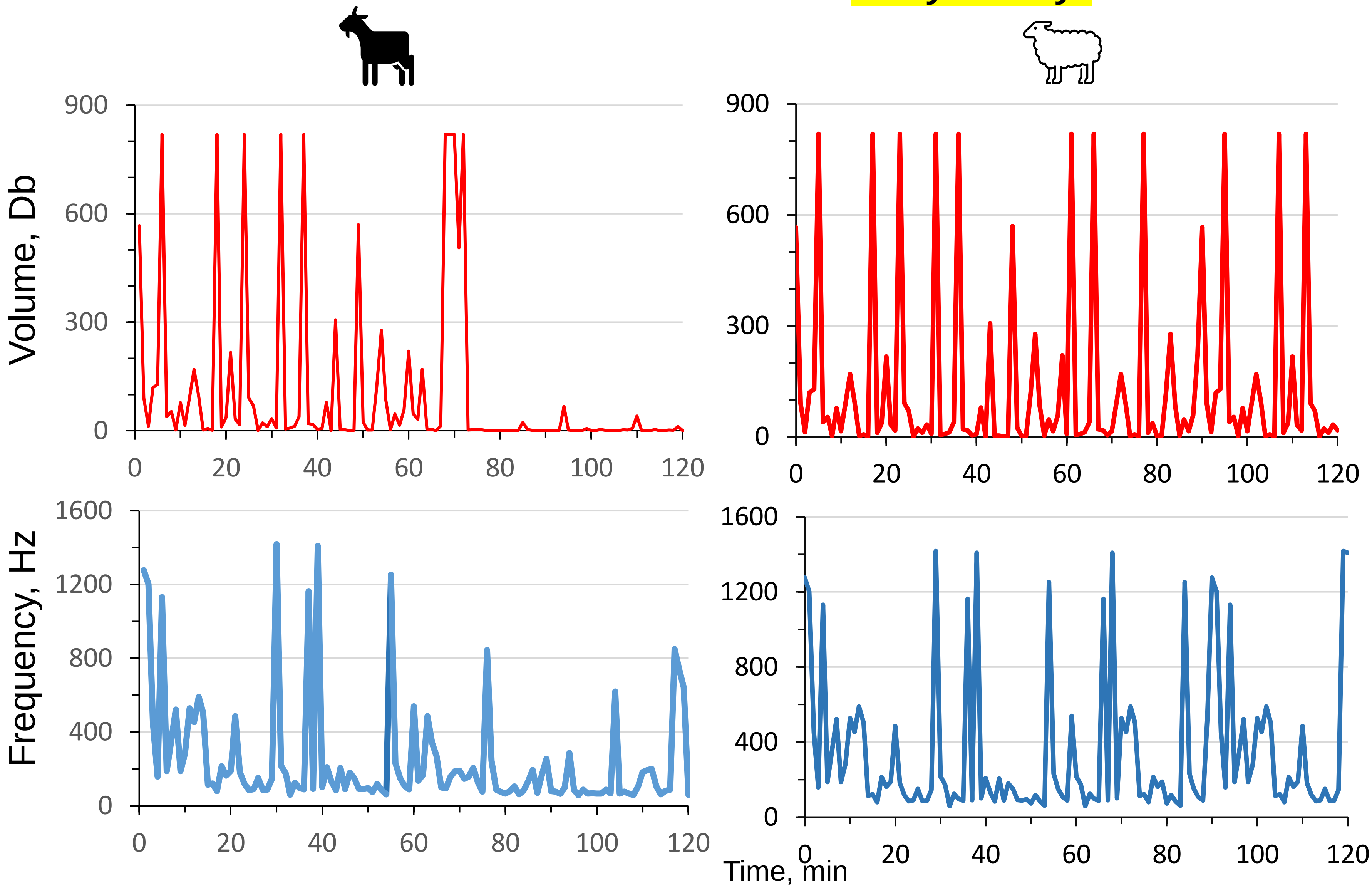
Results: Transport conditions in **lambs**

- Acceleration



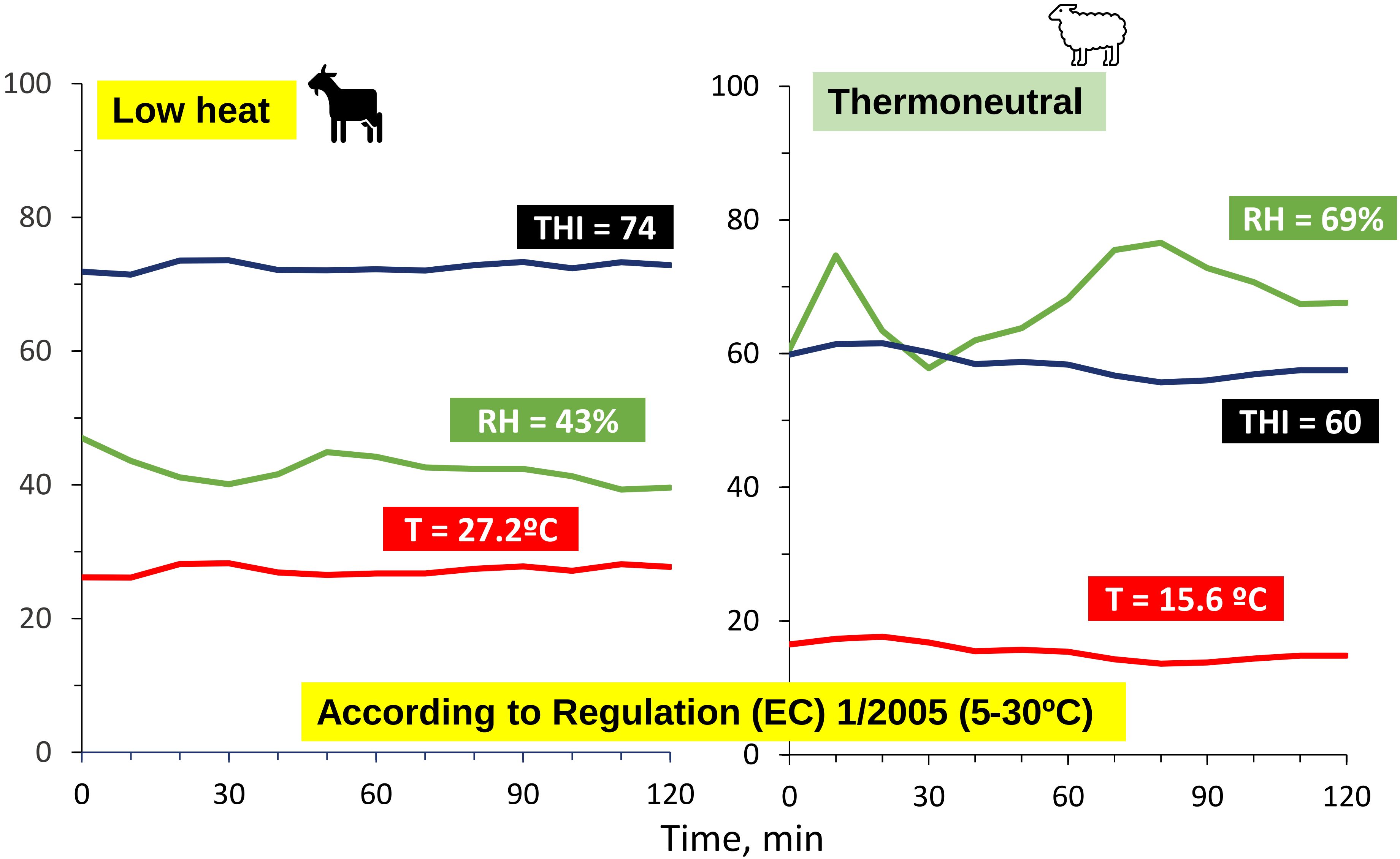
Results: Sound recorded during transportation

- Sound recorded in **kids** and **lambs**: Very noisy!



Results: Transport ambient conditions

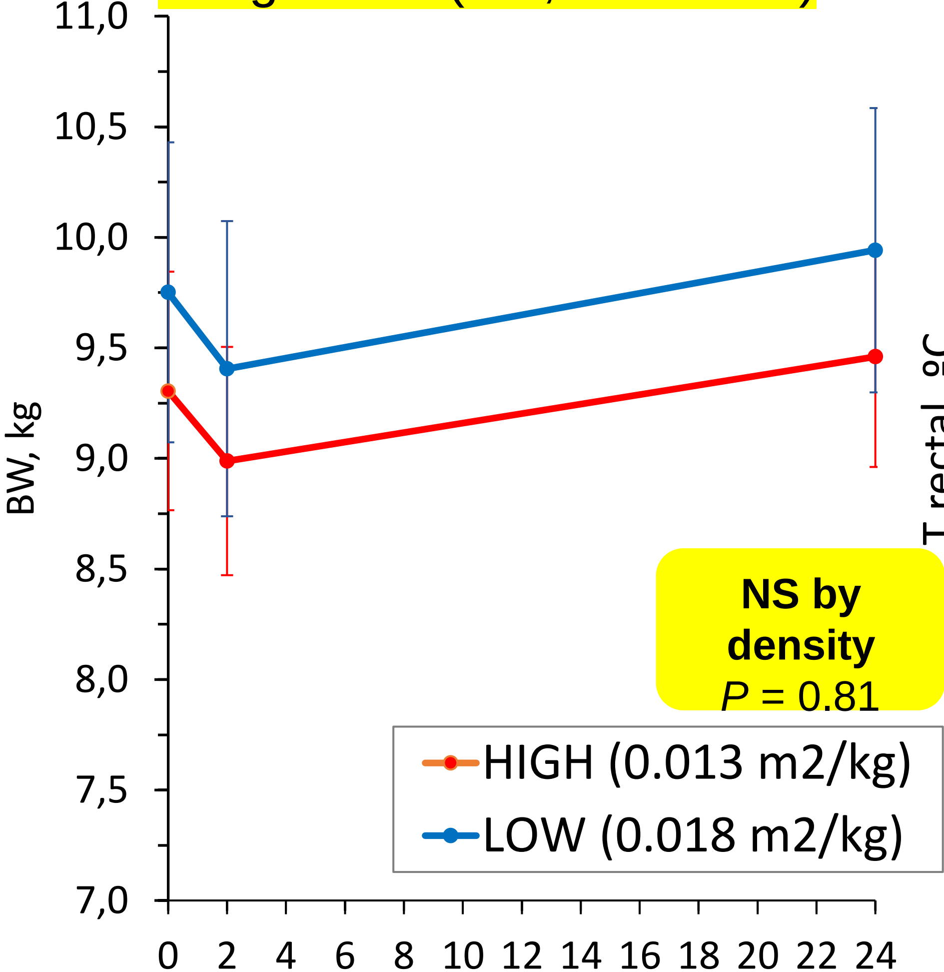
- THI (NRC, 1971) recorded in **kids** and **lambs**:



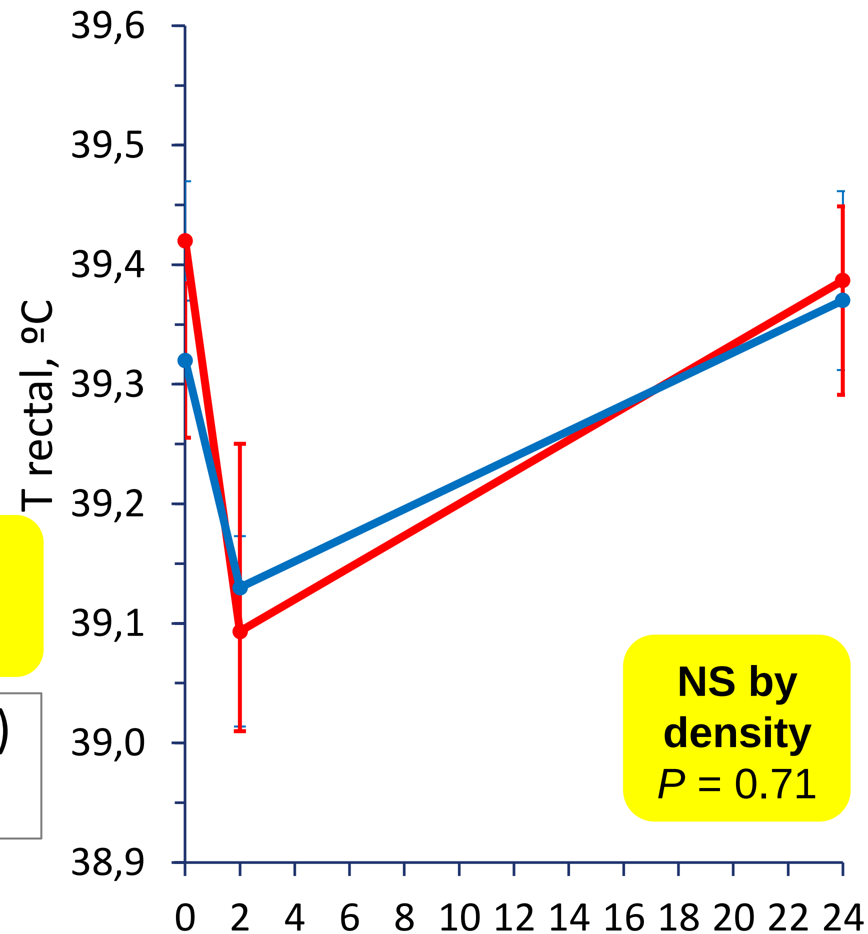
Results: Performances

- Body weight and rectal temperature in **kids** :

Weight loss (4%, *P* < 0.001)

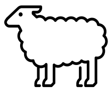


Temperature loss (-0.2ºC; *P* < 0.001)

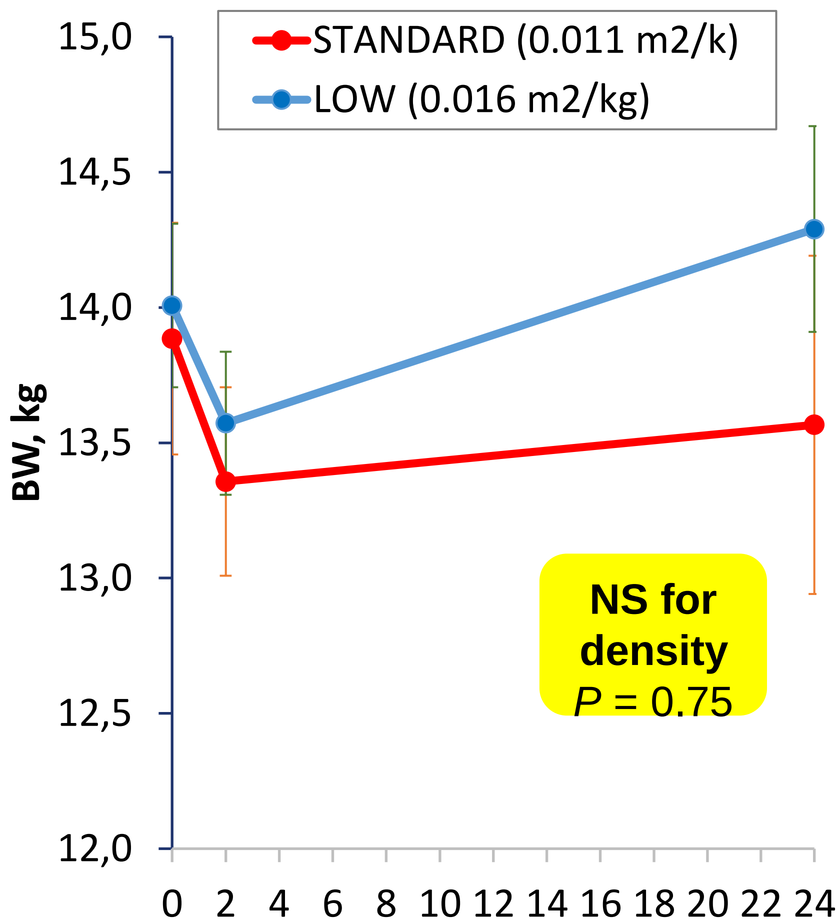


Results: Performances

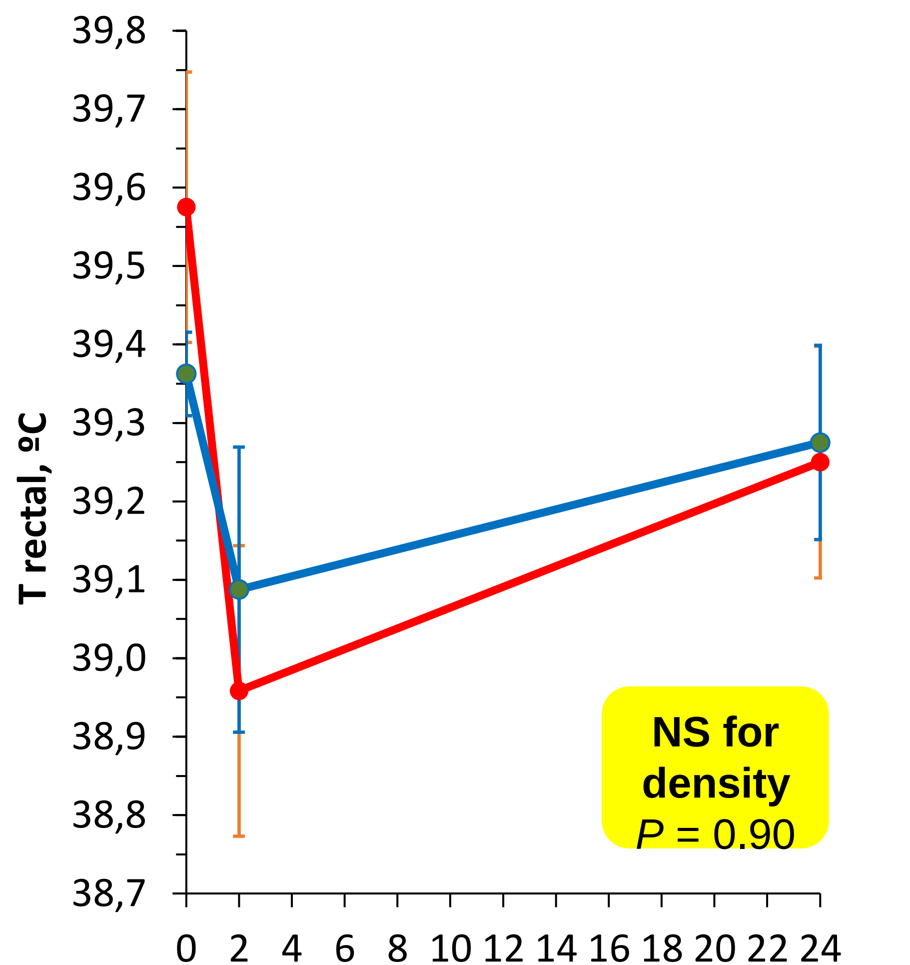
- Body weight and rectal temperature in **lambs**:



Weight loss (1%; $P < 0.01$)

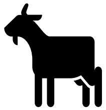


Temperature loss (-0.57ºC; P < 0.001)



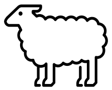
Results: Temperature correlations of IR

- No correlations with rectal temperature in **kids**:



Item	Rectal	Lacrimal	Iris
Mean	**39.3**	35.1	35.1
SE	±0.03	±0.10	±0.11
R^2 rectal	-	0.00003	0.0008
Trend	Concave	Convex	Concave

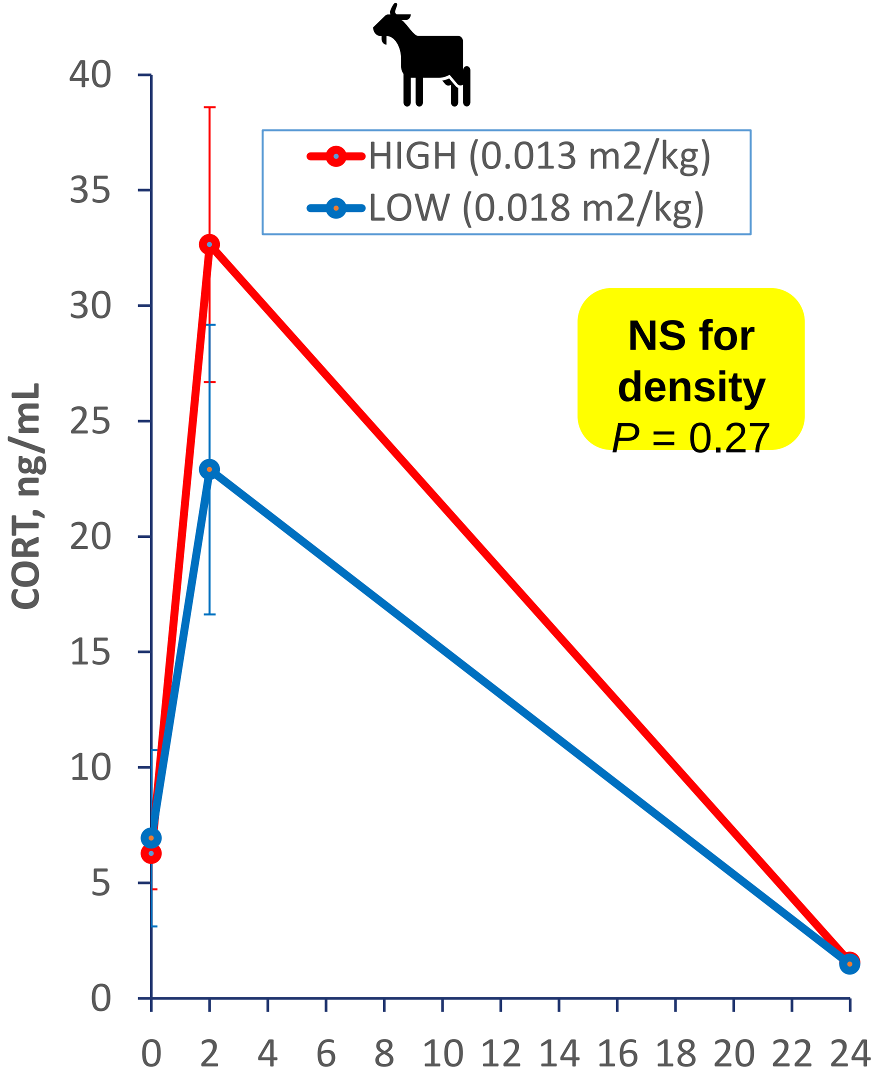
- No correlations with rectal temperature in **lambs**:

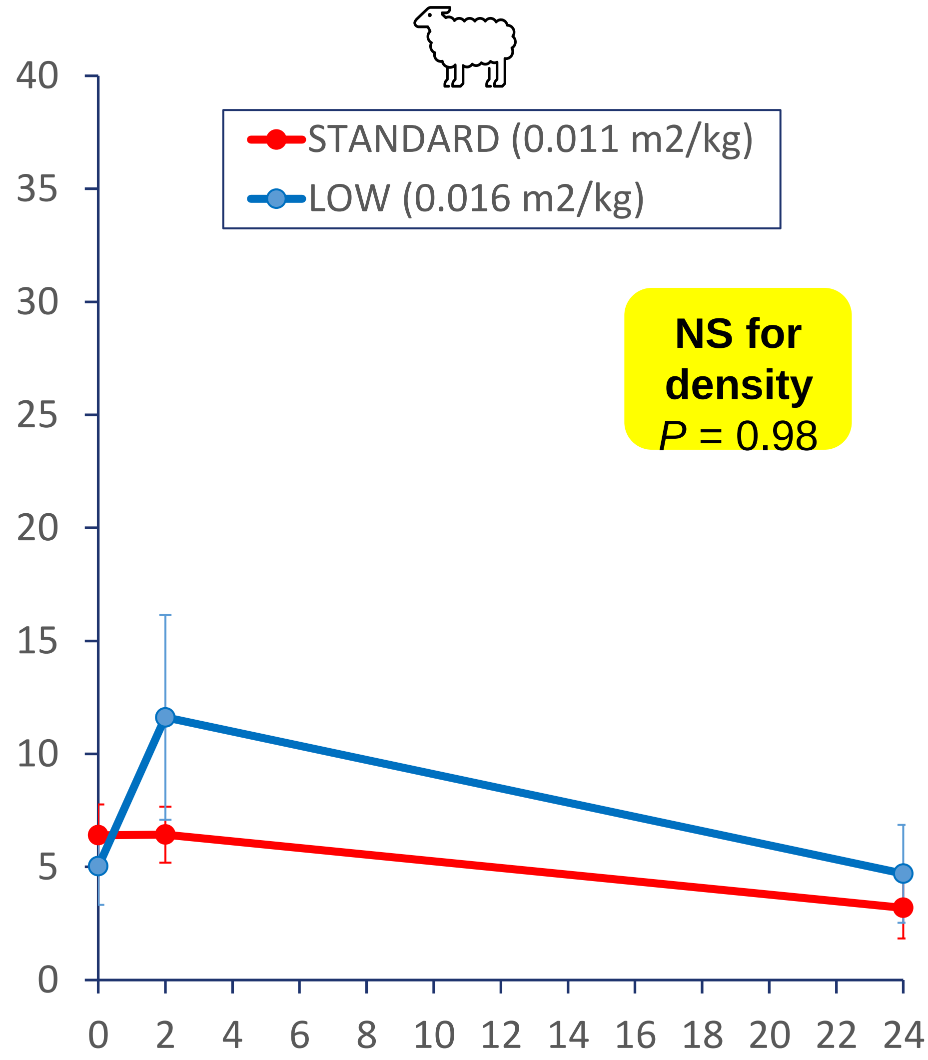


Item	Rectal	Lacrimal	Iris
Mean	**39.3**	35.1	35.1
SE	±0.03	±0.51	±0.50
R^2 rectal	-	0.0004	0.0007
Trend	Concave	Concave	Concave

Results: Metabolic indicators

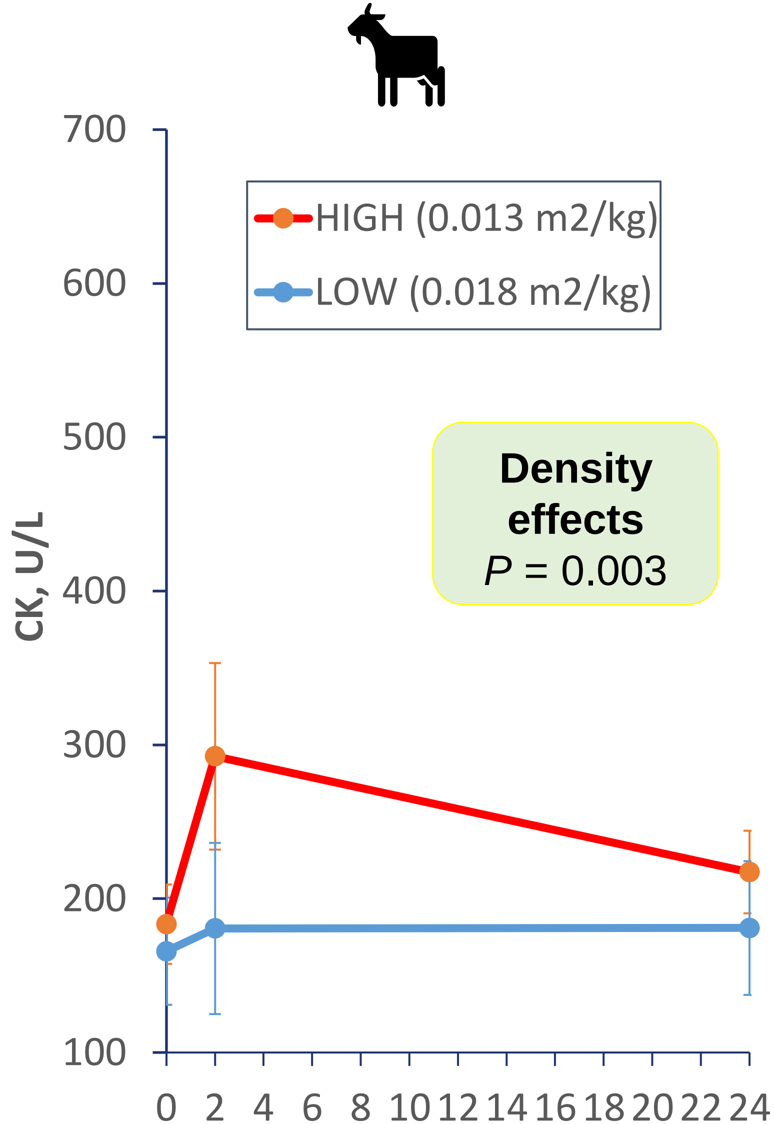
- Cortisol in **kids** and **lambs**:

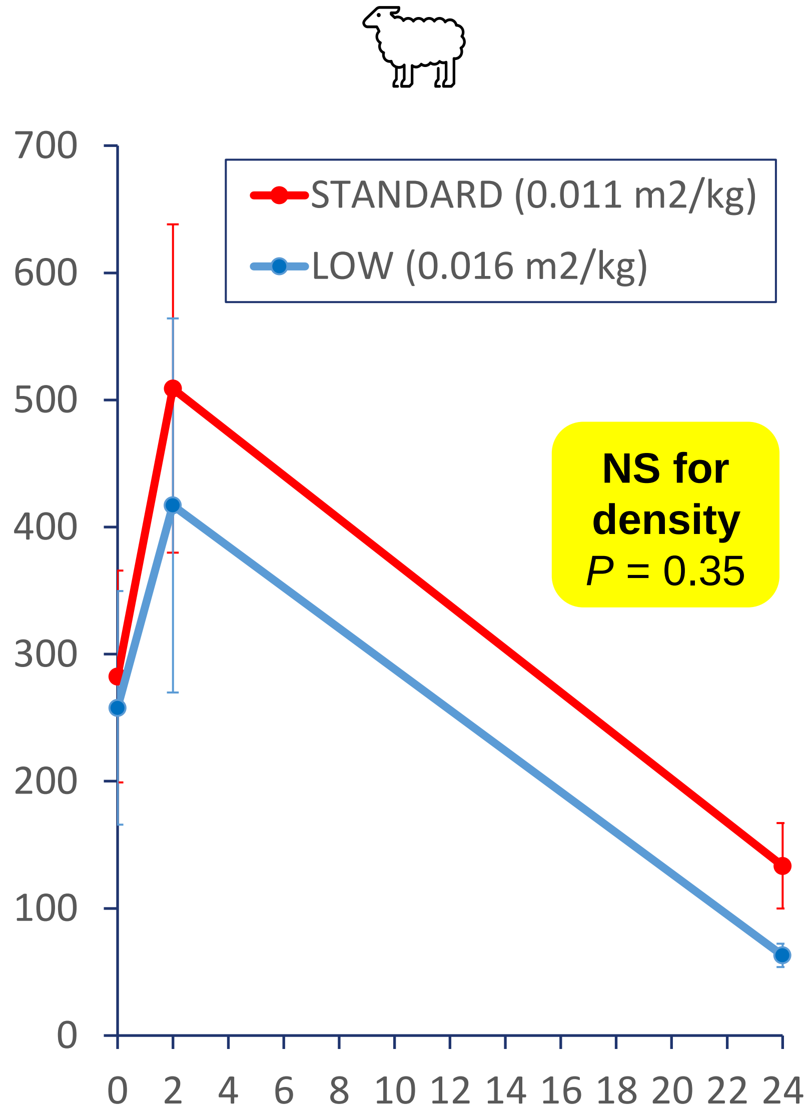




Results: Metabolic indicators

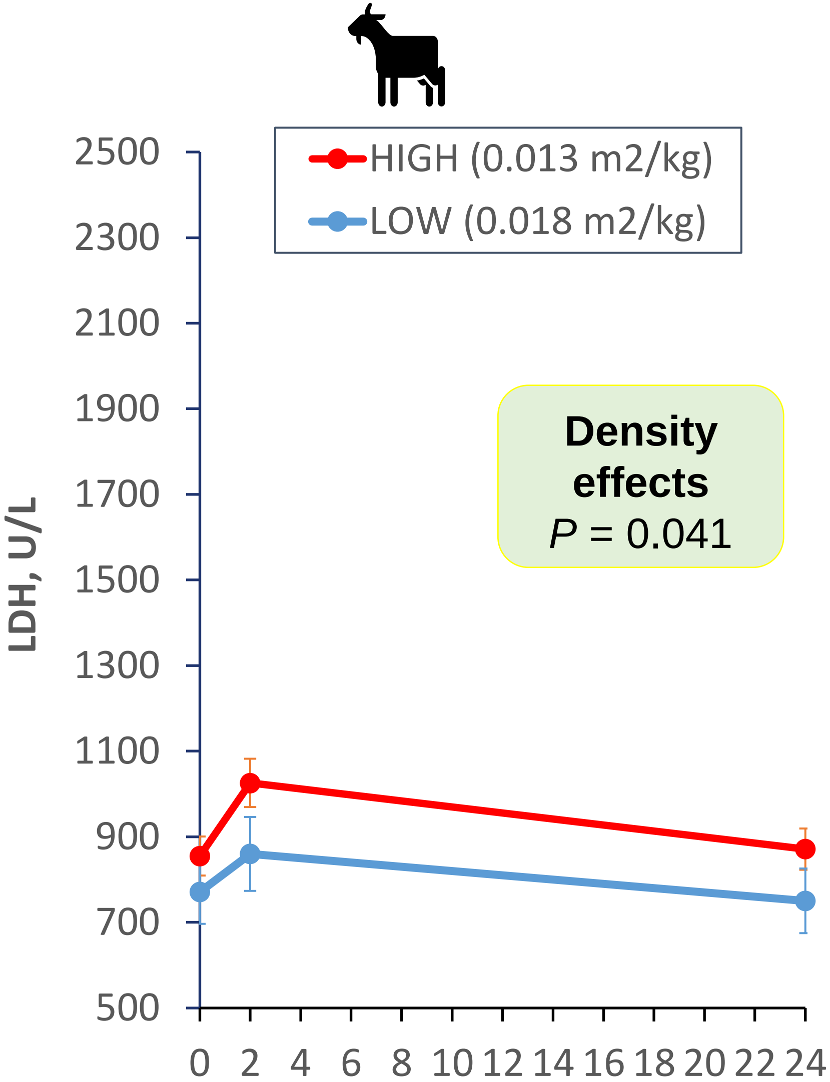
- CK in **kids** and **lambs**:

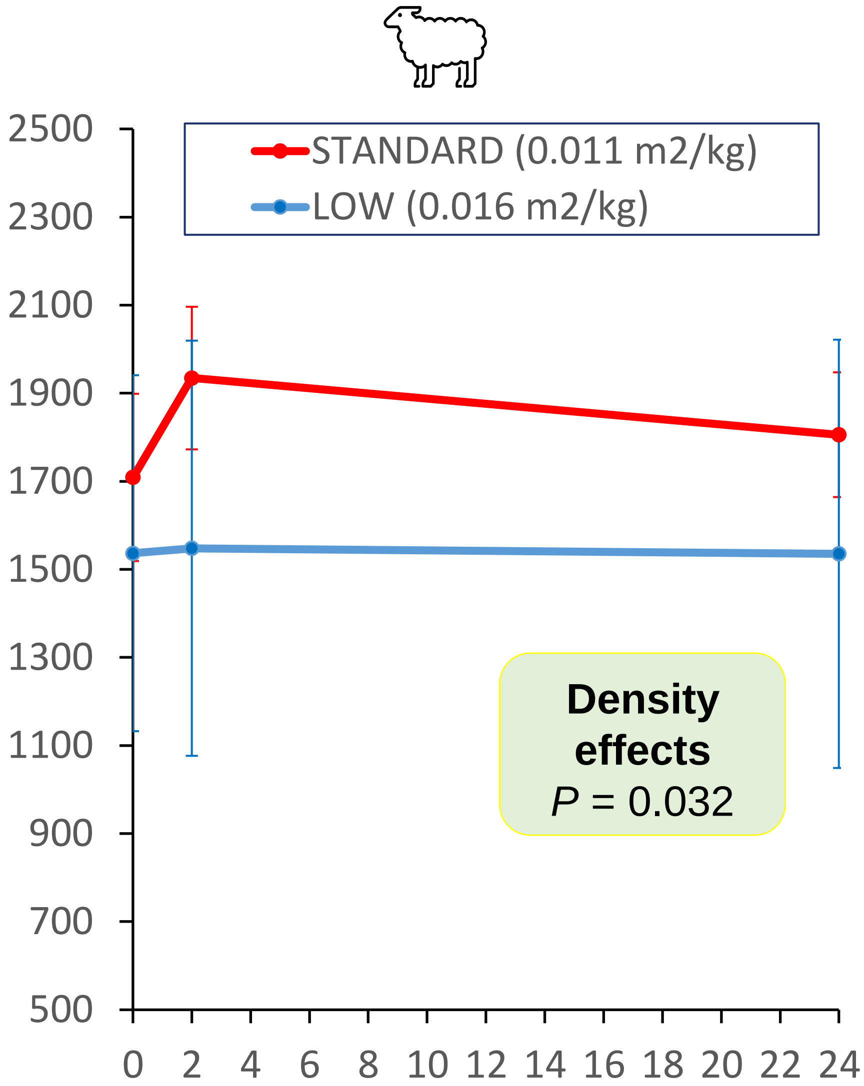




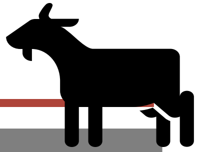
Results: Metabolic indicators

- LDH in **kids** and **lambs**:





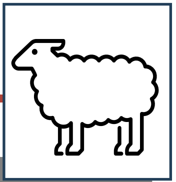
Results: Efffects of transport density in **kids**



Item	Low (0.018 m^2/kg)	High (0.013 m^2/kg)	± SE	Effect (P <)		
				Density	Sex	DxS
BW, kg	9.7	9.7	0.8	**0.81**	0.09	0.89
T_{Rectal}, ºC	39.3	39.3	0.1	**0.71**	0.92	0.64
Serum						
CK, U/L	228	391	113	**0.003**	0.62	0.87
Cortisol, ng/mL	10.1	11.6	3.7	**0.27**	0.47	0.30
Glucose, mg/dL	125	122	7	**0.71**	0.63	0.59
LDH, U/L	809	928	109	**0.041**	0.97	0.30
FFA, mmol/L	0.242	0.250	0.040	**0.99**	0.52	0.15
Urea, mg/dL	16.2	15.7	1.7	**0.64**	0.80	0.25

- No effects of density on BW and rectal temperature.
- CK response increased more in high than low (59 vs. 9%) density.
- LDH response was greater in high than low (20 vs. 12%) density.

Results: Effects of transport density in **lambs**



Item	Low (0.016 m^2/kg)	Standard (0.011 m^2/kg)	± SE	Effect (P <)		
				Density	Breed	Sex
BW, kg	13.9	13.6	0.5	**0.75**	0.53	0.62
T_{Rectal}, ºC	39.3	39.3	0.2	**0.90**	0.031	0.63
Serum						
CK, U/L	299	324	115	**0.35**	0.13	0.07
Cortisol, ng/mL	7.0	5.9	1.80	**0.98**	0.64	0.014
Glucose, mg/dL	130	116	7	**0.55**	0.85	0.83
LDH, U/L	1548	1763	226	**0.032**	0.76	0.022
FFA, mmol/L	0.220	0.299	0.075	**0.25**	0.14	0.47
Urea, mg/dL	18.5	18.8	1.5	**0.78**	0.21	0.42

- Rectal temperature drop 1% differed by breed (LC)
- CK tended to increase according to sex (F)
- Cortisol increased 122% by sex (M)
- LDH increased 14% with density (high) and 19% by sex (F)

Results: Carcass yield and quality in lamb

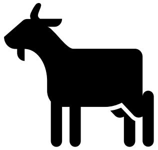
Slaughtered MN lambs:

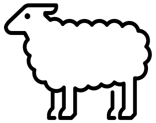
- **Carcass:** No differences by transport density on
  - Cold weight (7.30 ± 0.48 kg; $P = 0.23$)
  - Yield (53.4 ± 4%; $P = 0.19$)
  - Subcutaneous fatness (2.8 ± 0.5; $P = 0.73$)
  - Kidney fatness (2.5 ± 0.5; $P = 0.91$)

- **Meat color:**

  Only differences in meat color were observed, which tended to be **lighter at higher transport density** (1.8 vs. 2.8; $P < 0.10$) .

Summary: Effects of transport density over short distances





Item	Kids		Lambs	
	Low (0.018 m^2/kg)	High (0.013 m^2/kg)	Low (0.016 m^2/kg)	Standard (0.011 m^2/kg)
Number	15	10	12	8
BW	NS		NS	
T_{Rectal}	NS		NS	
Carcass traits	N/D		NS	
Meat color			Lighter (P < 0.10)	
Serum:				
CK	**+50%** (P = 0.003)		NS	
Cortisol	NS		NS	
Glucose	NS		NS	
LDH	**+8%** (P = 0.041)		**+12%** (P = 0.032)	
FFA	NS		NS	
Urea	NS		NS	

Conclusions

- Despite travelling short journeys (2 h), suckling kids and lambs were **stressed** (peak of cortisol).
- **Greater stress in kids** than in lambs.
- Animal performances and metabolic indicators **recovered by resting over night**.
- Marked vertical acceleration (**shocks**) and loud sound (**noise**) were detected, needing reduction in trailers.
- Both kids and lambs showed **cold stress signs**, despite the mild weather during the journey (THI = 60-74).
- **High transport densities increased** the metabolic response of **CK** and **LDH**, indicating muscle damage and energy utilization.
- The use of low densities (**greater than 0.015 m^2/kg** or 0.15 m^2/animal) are recommended for light kids and lambs.

Implications

- A **new experiment** with a greater number of animals will be done in the next kidding-lambing season (next autumn).
- Regulation (EC) should be amended for **including**:
  - **Minimum space** (>0.010 m^2/kg) **and temperature** conditions (THI > 75?) for light kids and lambs.
  - **Maximum acceleration and noise** levels.
  - Recommendation on the **use of closed trailers** with efficient shock absorbers and climatization.

Thank you !!

TECH CARE

Integrating innovative TECHnologies along the value Chain
to improve small ruminant welfARE management

www.techcare-project.eu

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