Development of long-term, pre-finishing immunocastration protocols for male Iberian pigs. 1: Efficacy

EAAP 2018
69th Annual Meeting of the European Federation of Animal Science
Dubrovnik, Croatia,
27th to 31st August 2018

Francisco I. Hernández García

TREASURE
Diversity of local pig breeds and production systems for high quality traditional products and sustainable pork chains

Funded by European Union
Horizon 2020
Grant agreement No 634476

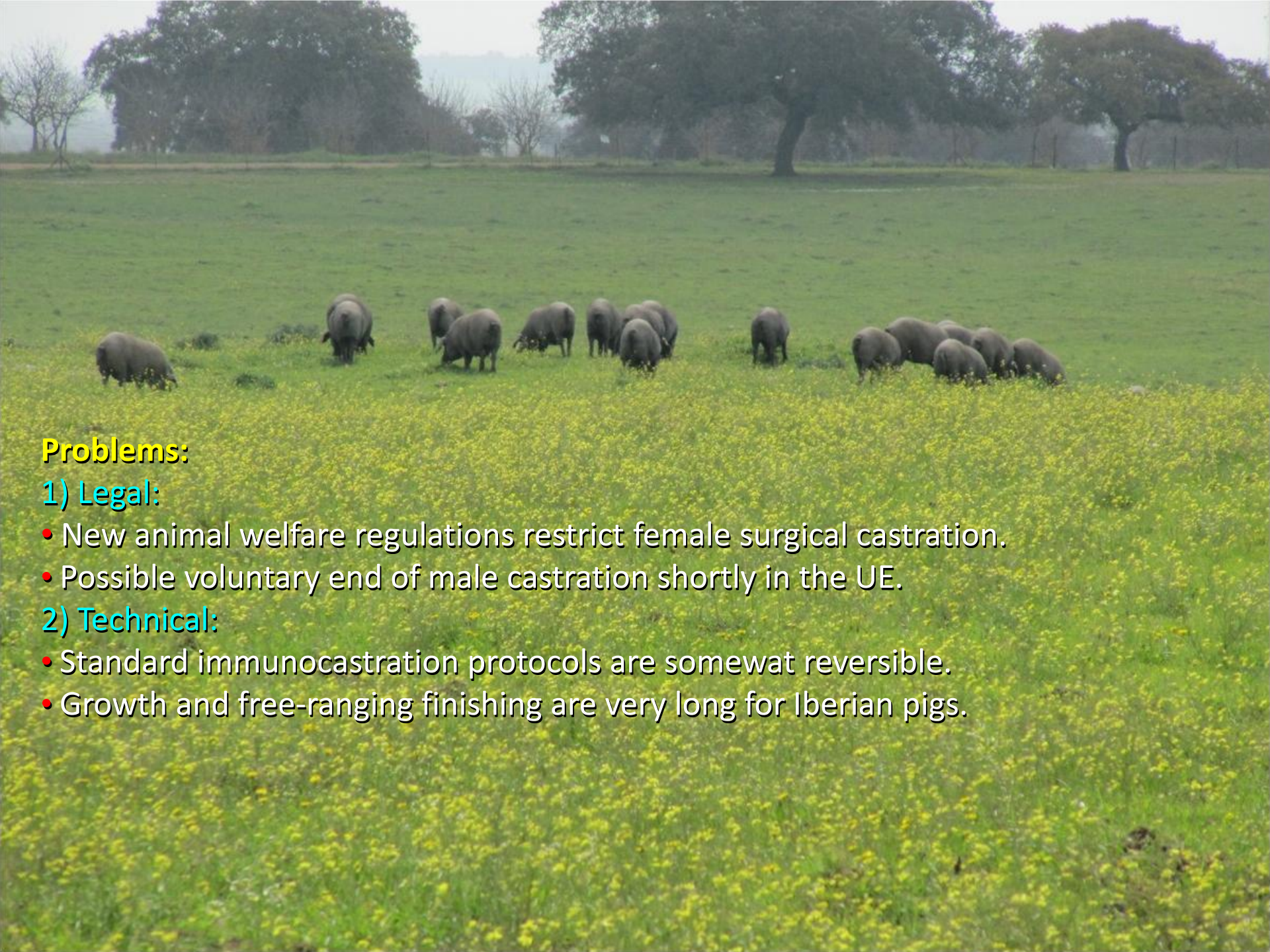
CICYTEX
CENTRO DE INVESTIGACIONES CIENTÍFICAS Y TECNOLÓGICAS DE EXTREMADURA

INIA
Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria

INTRODUCTION

Reasons for surgical castration of Iberian pigs: (males & females)

- To avoid boar taint in meat of males.
- To facilitate free-ranging management. To avoid unwanted pregnancies .
- To increase intramuscular fat deposition.



Problems:

1) Legal:

- New animal welfare regulations restrict female surgical castration.
- Possible voluntary end of male castration shortly in the UE.

2) Technical:

- Standard immunocastration protocols are somewat reversible.
- Growth and free-ranging finishing are very long for Iberian pigs.

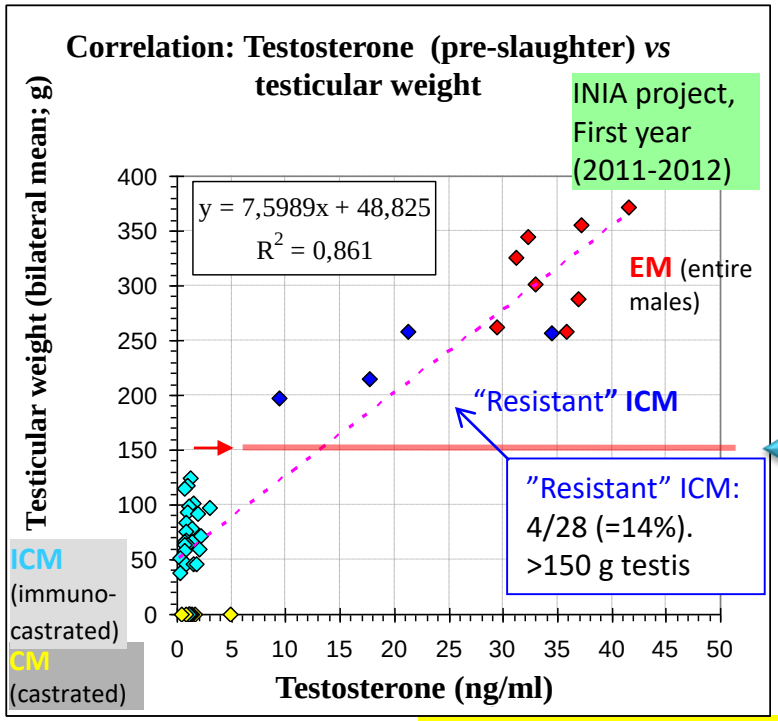
INITIAL STUDIES

I. FEMALE PRE-PUBERTAL & PRE-FINISHING IMMUNOCASTRATION

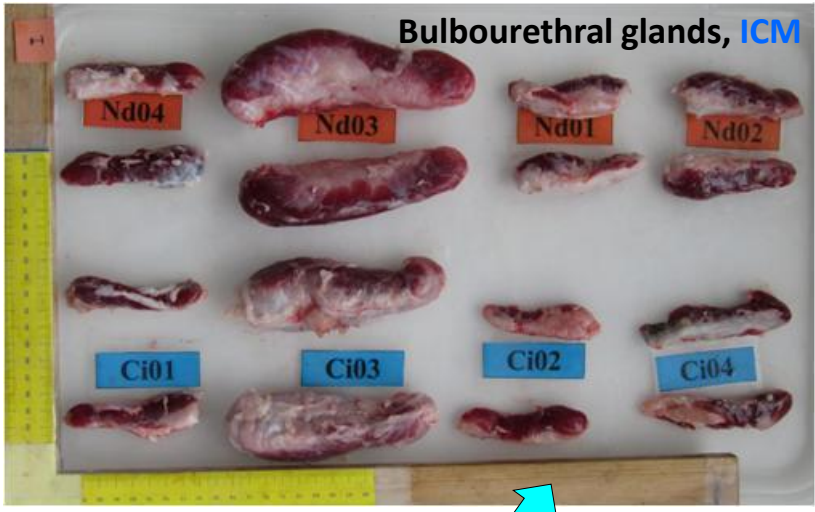
- 3-dose protocols; slaughter at 16 months of age.
- Both protocols had a 100% efficacy.
- They were directly transferred to the Iberian pig sector.

II. MALE PRE-PUBERAL & PRE-FINISHING IMMUNOCASTRATION

- Efficacy was high but variable (80% to 100% depending on the trials), with highly variable testicular atrophy degrees.
- The prepubertal protocol may revert in some individuals.
- Efficacy appeared to be affected by different factors like nutritional level and stress.

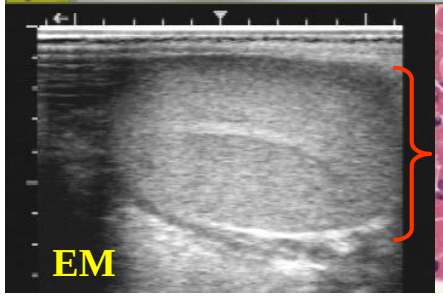


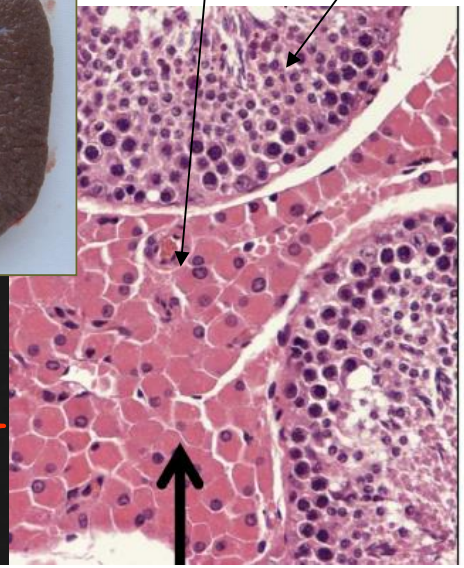
150 g threshold for blood testosterone presence



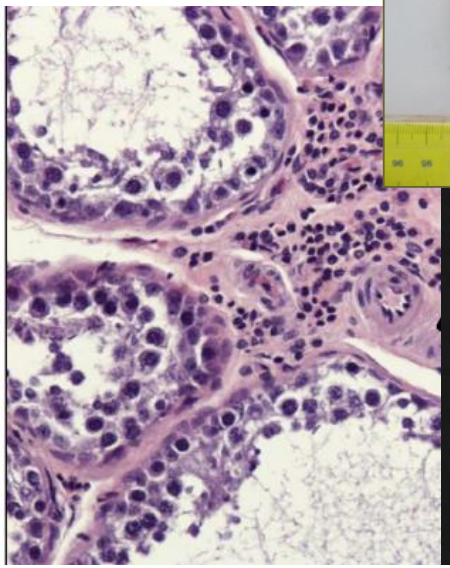
Representative testes & accessory glands

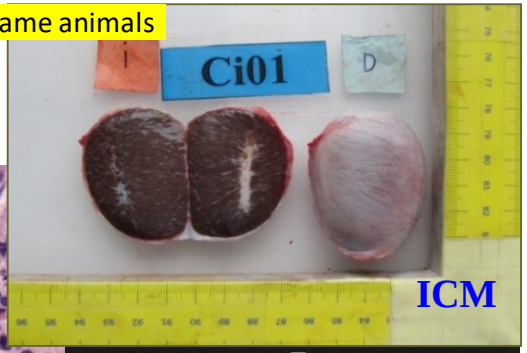
INIA 2011-2013 project. Echography, photography & histology from the same animals

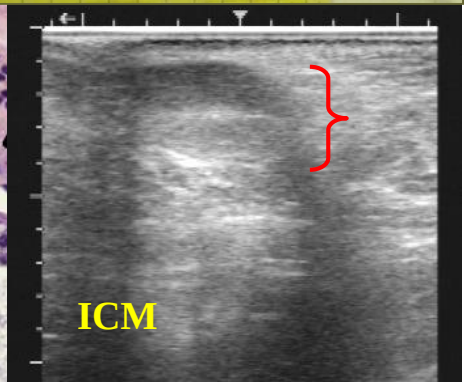


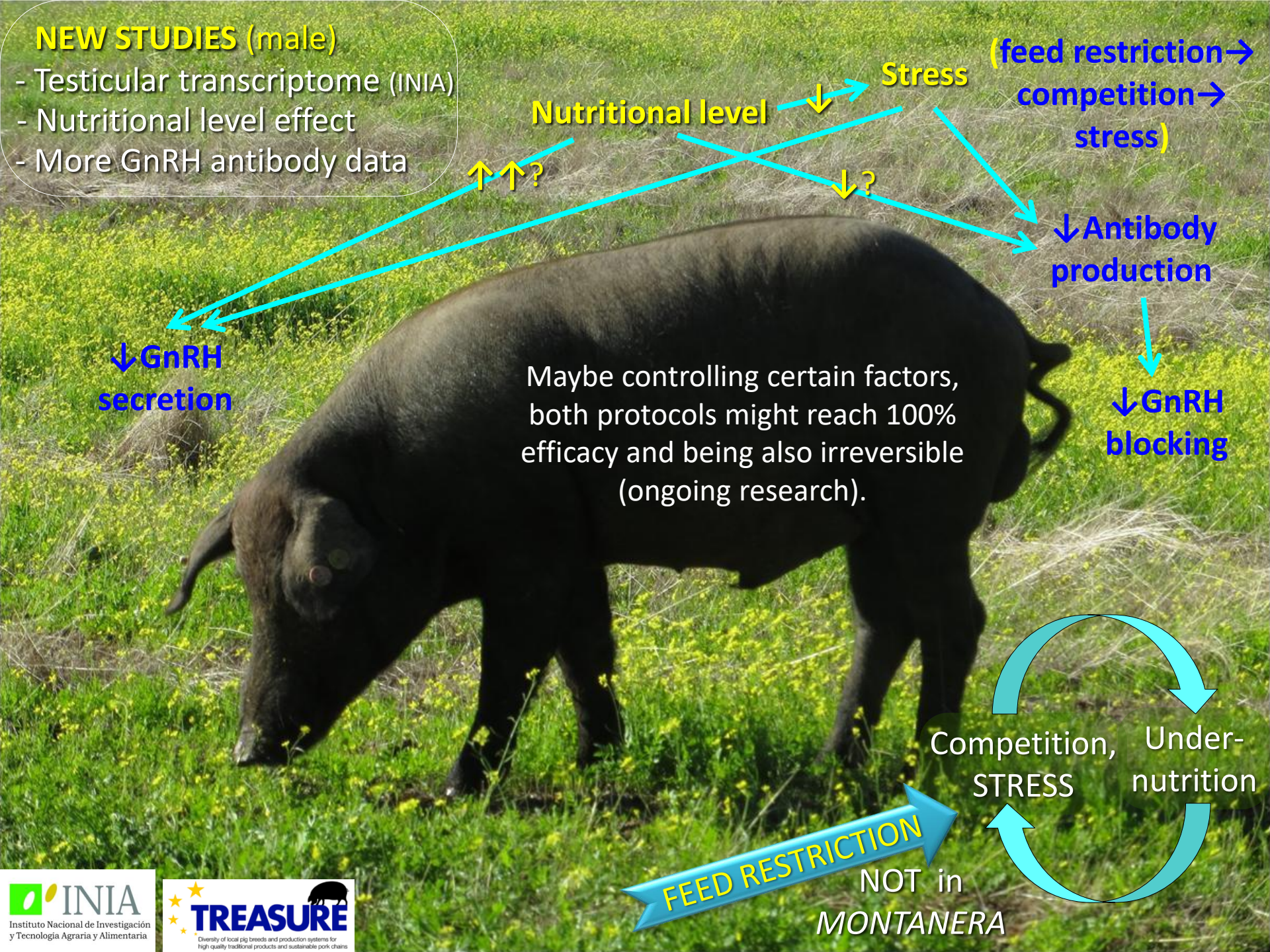


Atrophy & degeneration








NEW STUDIES (male)
- Testicular transcriptome (INIA)
- Nutritional level effect
- More GnRH antibody data
Nutritional level
↓
Stress
(feed restriction→ competition→ stress)
↑↑?
↓?
↓Antibody production
↓GnRH secretion
↓GnRH blocking
Maybe controlling certain factors, both protocols might reach 100% efficacy and being also irreversible (ongoing research).
Competition, STRESS
Under-nutrition
FEED RESTRICTION
NOT in MONTANERA
INIA
Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria
TREASURE
Diversity of local pig breeds and production systems for high quality traditional products and sustainable pork chains

STUDY 1: Effect of feeding management on the efficacy of long- term male immunocastration protocols specifically designed for Iberian pigs

INIA
Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria

METHODOLOGY

STUDY 1

System:

- Pigs were raised in a conventional, concentrate-based extensive system.

Immunocastration protocols:

- Late-immunocastrated males (**L-ICM** group; n=47) were immunized against GnRH at 11, 12 and 14 months of age.
- Early-immunocastrated males (**E-ICM** group; n=39) were immunized at 4.5, 5.5 and 9 months of age.
- Entire males (**EM**; n=5) were used as general controls.
- All pigs were slaughtered at 16 months of age.

Feeding management intervention:

- Approximately half of each IC group were submitted to a 15-day *ad libitum* feeding period starting at the 3rd vaccination (Treated subgroups; **trt**; 23 L-ICM and 19 E-ICM), during which hopper-type feeders (*) were set in large corrals to minimize competition and stress. The remaining IC males belonged to Control (**ctrl**) subgroups.

Data collection: ***1) In vivo*:**

- Body weight (monthly) and hip height (twice).
- Testicular echography (≥4 times): size, echotexture.
- Blood sampling (≥3 times): testosterone, anti-GnRH antibodies. (Data not yet available).
- Body composition echography (≥ 2 times).

Weighing & echography crate

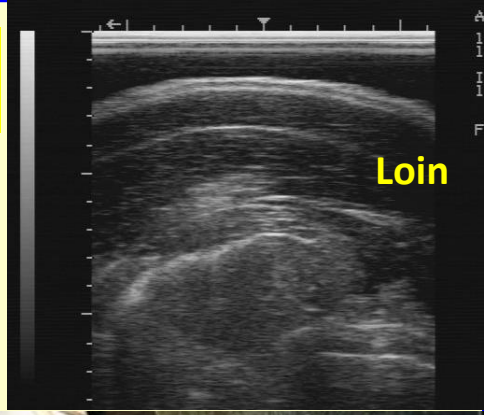
Blood sampling

Caliper

Scanning

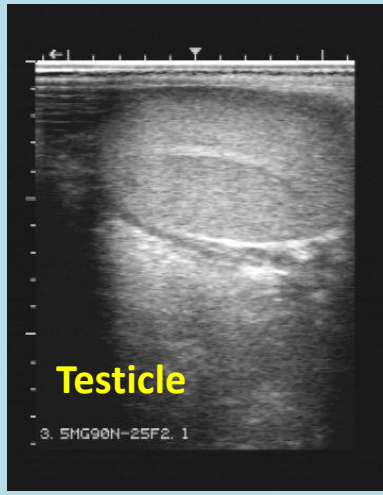
Body composition

3.5 MHz, 12cm longitudinal probe



Testicular echography

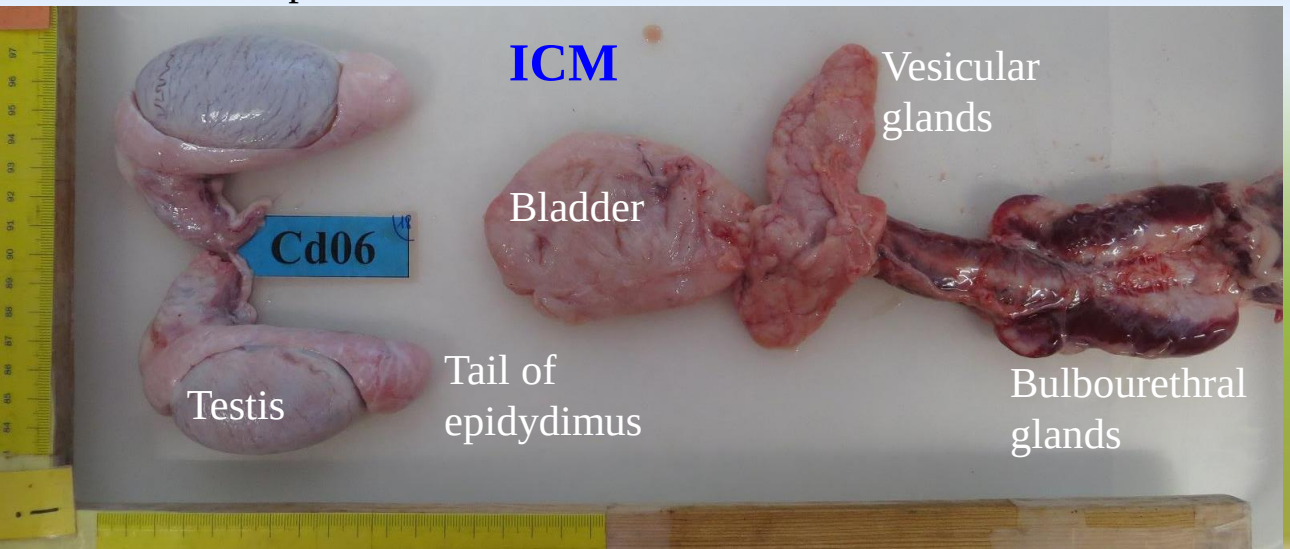
Same probe (3.5 MHz 12cm)



Data collection: *2) Postmortem:*

- Carcass and meat quality: Weights and measurements, intramuscular fat, fatty acid profile. (in TREASURE session)
- Fat sampling for androstenone & skatole analyses. (Data not yet available)
- Tomography of hams and consumer acceptance studies (IRTA collaboration).
- Genomics: Testicular and liver sampling for transcriptome analyses (INIA collaboration).
- Morphometry of reproductive tract:
  - Testicular weight and volume.
  - Epididymal weight.
  - Accessory glands (bulbourethral and vesicular) weight & measurement.
- Colorimetry of testicular parenchyma.
- Testicular sampling for histological studies.

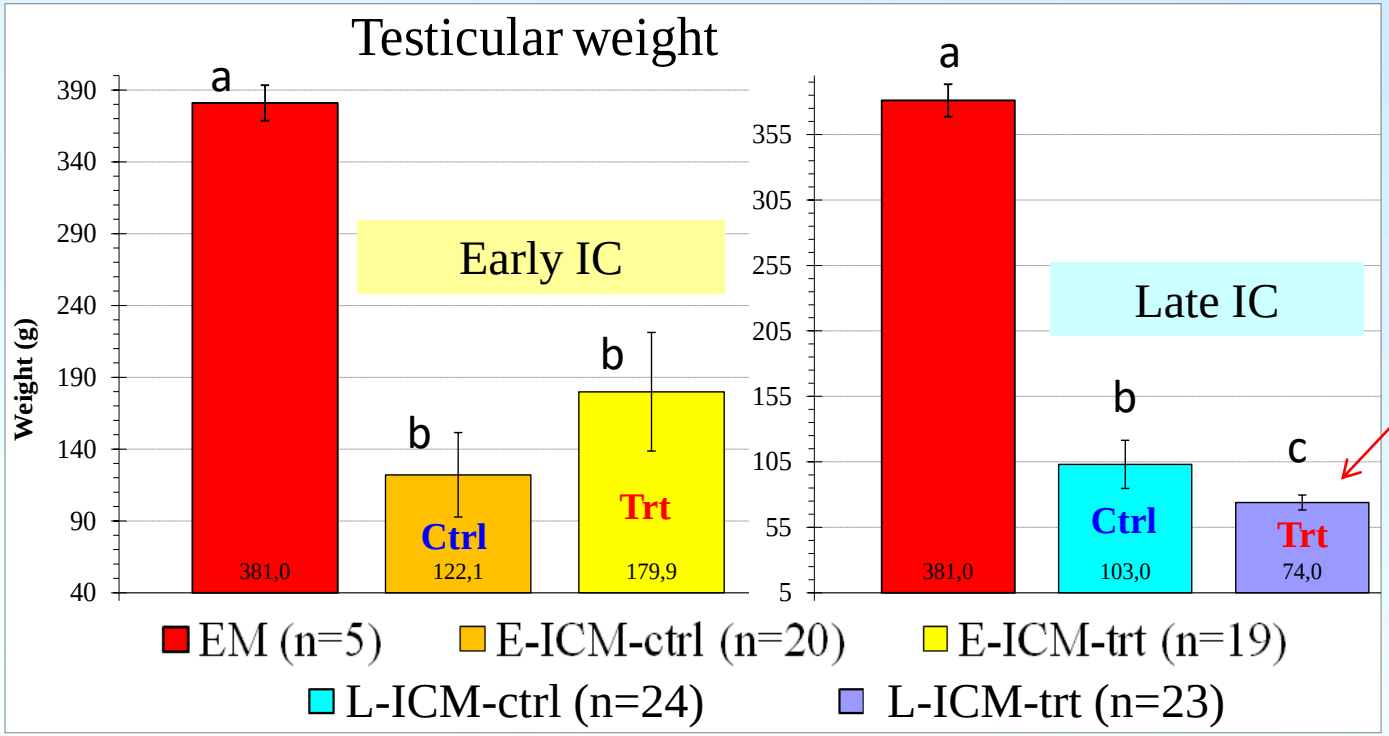
Reproductive tract of an Immunocastrated Male



Water displacement technique

Preliminary RESULTS

STUDY 1



Trt: 15-day *ad libitum* feeding

Deepest and most homogeneous atrophy

Testicular weight ranges (g)	E-ICM-ctrl	E-ICM-trt	L-ICM-ctrl	L-ICM-trt
Minimum:	8,5	14,1	43,4	36,1
Maximum:	386,4	593,6	386,7	143,0

All *ad libitum*-treated L-ICM were full responders (<150-g testes)

• A 100% efficacy was reached by the feeding-modified Late protocol, as all Treated L-ICM had <150-g testes (threshold for blood testosterone presence in our earlier studies).

- In contrast, some animals in the other subgroups (4/24 Control L-ICM, 6/20 Control E-ICM and 8/19 Treated E-ICM) had >150-g testes.

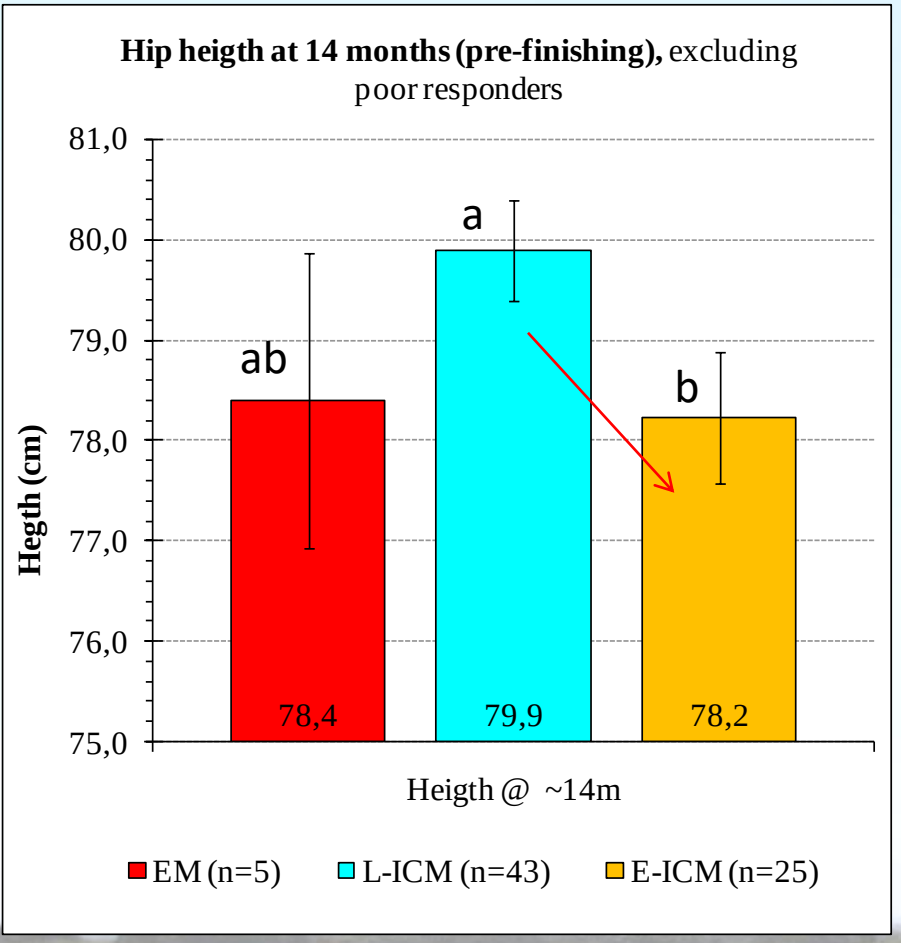
- Interestingly, after deep testicular atrophy, poor-responding E-ICM exhibited testicular growth (reversion; delayed and exacerbated “puberty”).

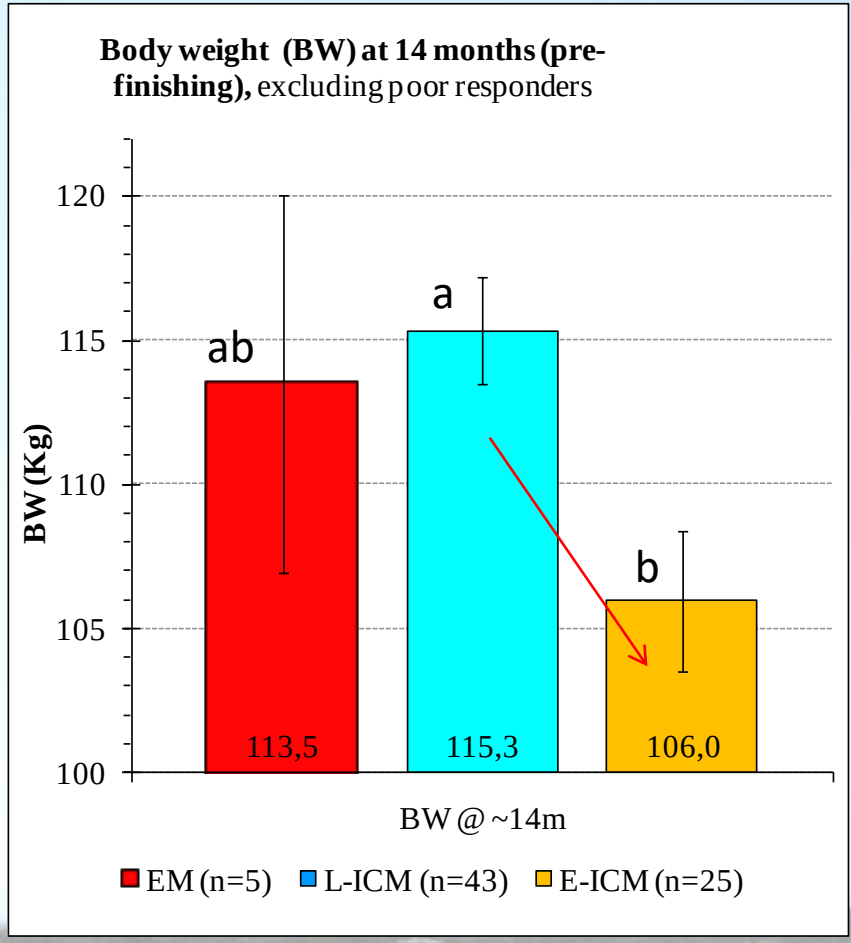
Representative examples: 2 Entire Males (red tag). 15 fully-imunocastrated Late-IC Males, showing atrophy and “brown & marbling degeneration”.

Testes from Early (pale) and Late (brown) Immunocastrated Males.

Body development in relation to time undergoing testosterone (anabolic) deprivation:

- Among the fully immunocastrated animals (<150g testes), the Late ICM were heavier than the Early ICM at 14 months of age (just before finishing)





Early immunocastration facilitates management in extensive conditions, but Late immunocastration may have an advantage in growth.

CONCLUSIONS (Study 1)

- A short-term nutritional level increase can be used to improve (to 100%) the efficacy of Late male IC protocols in Iberian pigs.
- In contrast, the pre-pubertal protocol could not be improved by feeding management intervention.
- **Implications:** New research is being conducted to develop a fully effective early protocol.

STUDY 2: Male pre-finishing immunocastration protocol: Adaptation to *montanera*

Rationale: Improving body condition at the start of *montanera* will improve and homogenize testicular atrophy and also carcass composition. Besides, vaccinations should finish before montanera to facilitate management.

TREASURE
Diversity of local pig breeds and production systems for high quality traditional products and sustainable pork chains

METHODOLOGY

STUDY 2

METHODOLOGY: Immunocastration protocols & chronogram:

- **Control** pigs: Vaccination (**V**) at 10.5, 12 and 13.5 months of age (V3 at *montanera* start)
- **Treated** pigs: V at 10.5, 11.5 and 13 m (V3 15 days before *montanera*). 5-day *ad libitum* feeding after V3.
- ***Montanera*** starts at 13.5 m. Slaughter at 16 m.
- **Adlib** group (Iberian x Duroc): *Ad libitum* during growth & finishing (To further study the effect of nutritional level). Vaccinations at 8, 9 and 10 m. Slaughter at 13 m (earlier, due genotype feeding system).

		Large paddocs							*Montanera* (in *dehesa*)		
		Ages (months) & Dates							2015	2016	
		8	9	10	10.5	11.5	12	13	13.5	14	15	16
	n								15-nov		jan	feb
Adlib (Ib. x Duroc)	15	V1	V2	V3 E				E *				
Control (Iberian)	18				E V1	_1.5m_	E V2	_1.5m	E V3			E *
Treated (Iberian)	17				E V1	V2	E _1.5m_	V3	E			E *

Body weight
E Testicular echography
Body composition echography
V Vaccination (Improvac)
Ad libitum feeding
Slaughter, carcass & meat study
* Blood sampling

Ad libitum feeding of one group at the end of *premontanera*

Montanera feeding (3 months) up to 16 months of age

Data collection: (Similar to STUDY 1)

***1) In vivo*:**

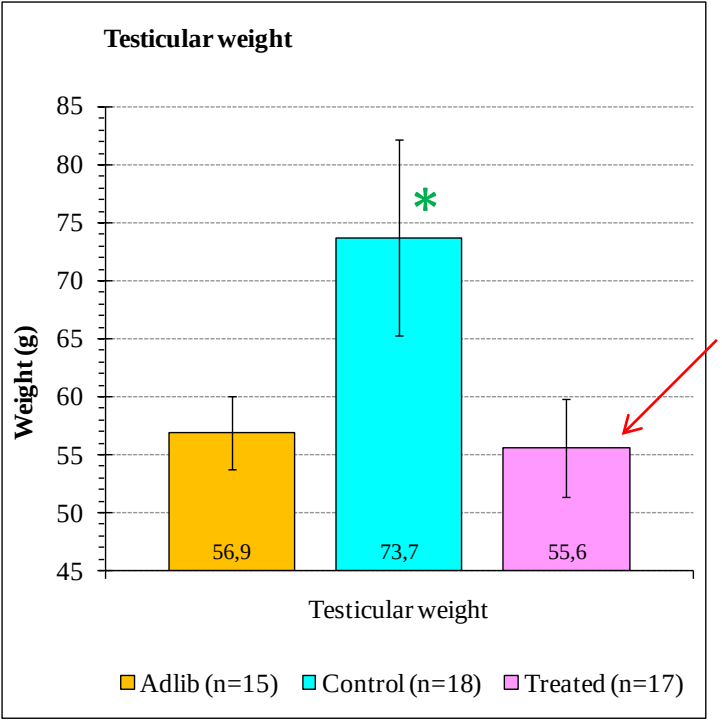
- Body weight.
- Testicular echography.
- Blood sampling: testosterone (pre-slaughter). *(Data recently available).*
- Body composition echography.

2) Postmortem:

- Carcass and meat quality.
- Fat sampling for androstenone & skatole analyses (within WP3 of TREASURE).
- Morphometry of reproductive tract.
- Colorimetry of testicular parenchyma.

RESULTS

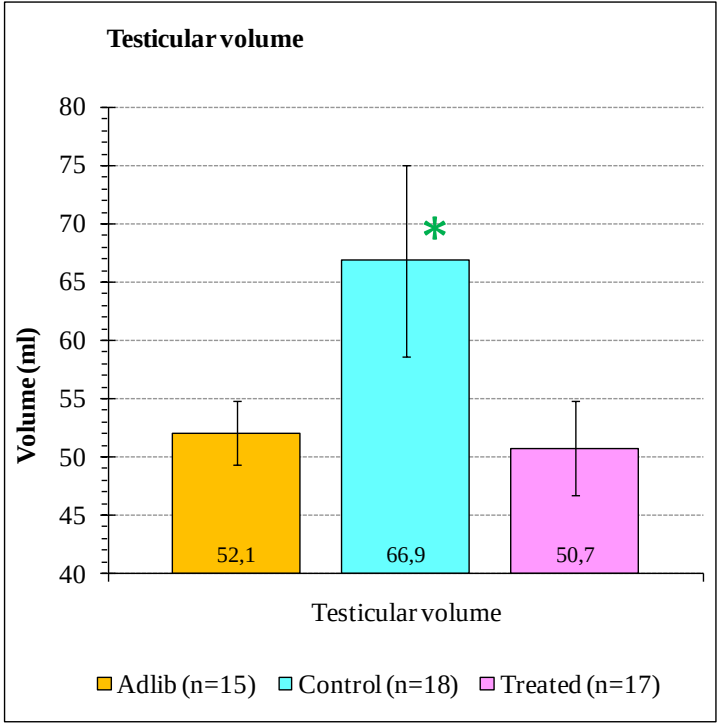
STUDY 2



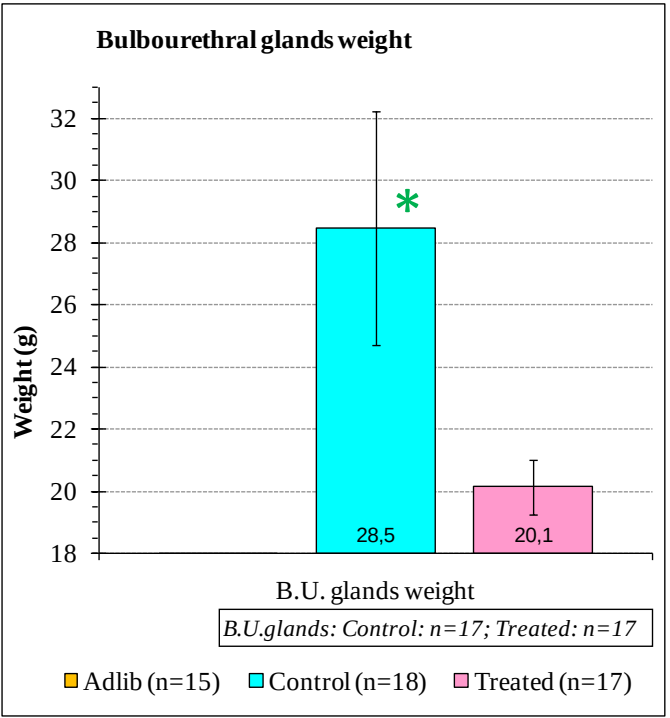
- Animals remained immunocastrated for the whole finishing period (3 months) (regular extensive or *montanera*).

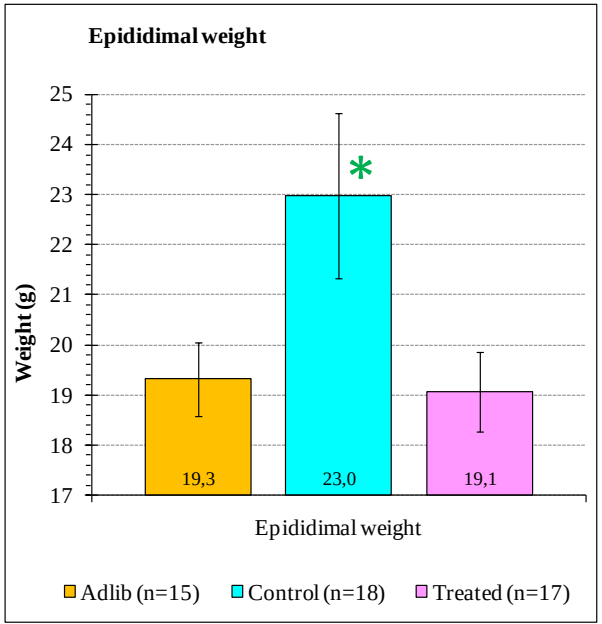
-The treatment (15d ↑feeding) improved the efficacy of immunocastration (grater and more uniform atrophy).

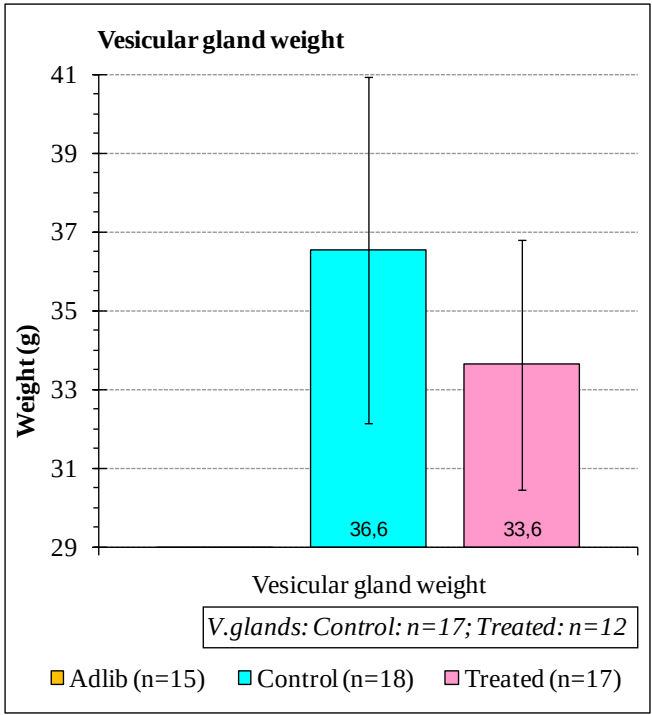
- Unrestricted feeding (Adlib group) had a similar effect.

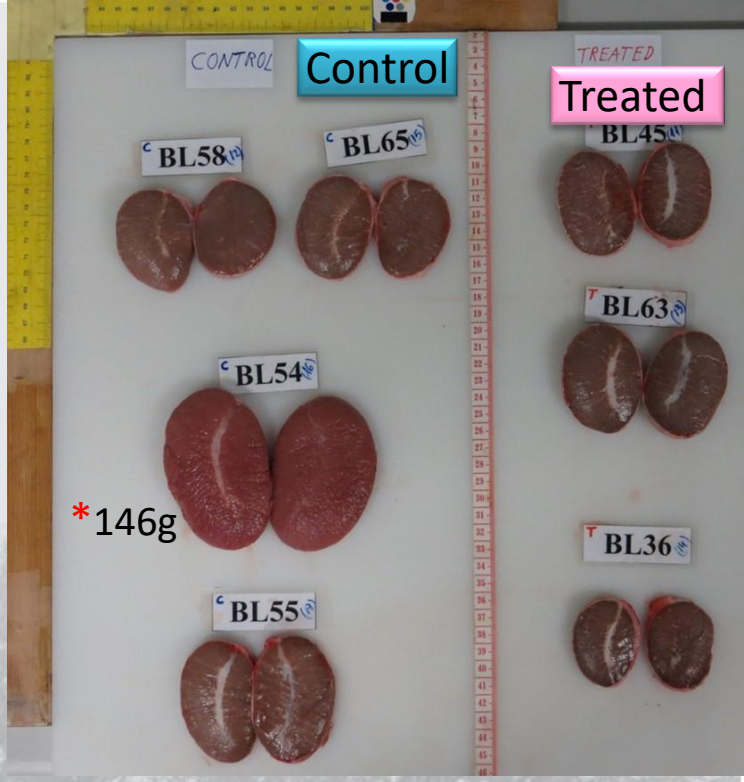


(bilateral means)





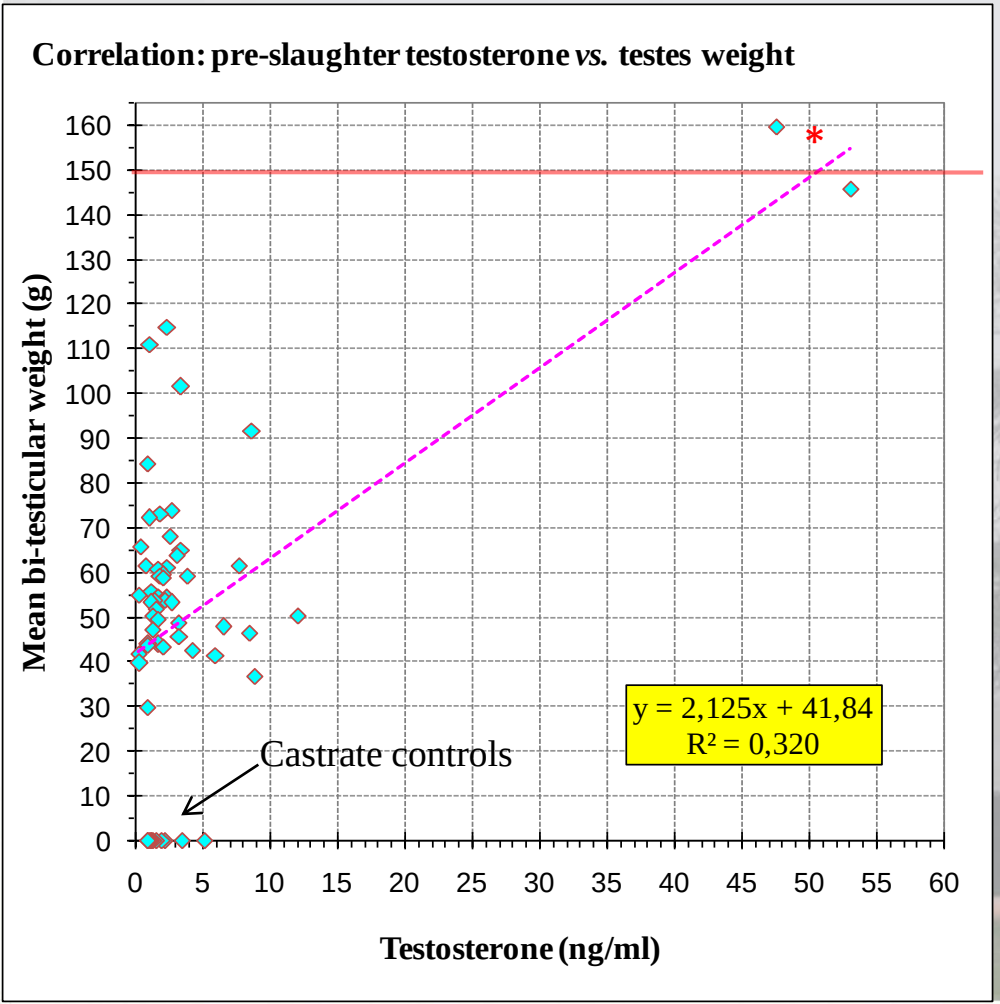




- Adlib and Treated groups had small testicles (all <150g) (100% efficacy).
- Control group: 2 pigs had ~150g testicles (*)

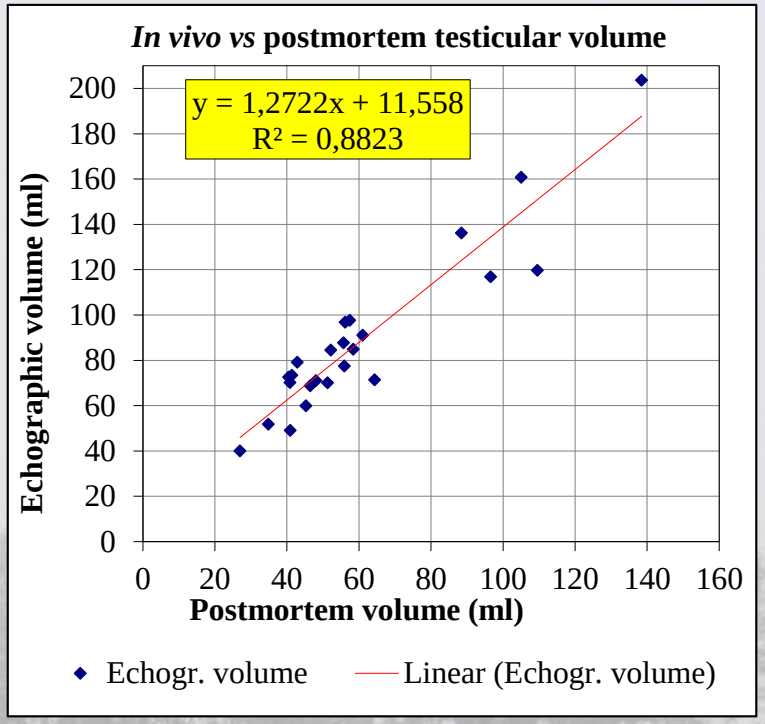
- Fat samples (n=48) were negative for **androstenone** (<0,24 µg/g) and skatole (<0,01 µg/g).
  (But, accidentally, fat samples from the 2* Control IC males with ~150 g testes were not available).

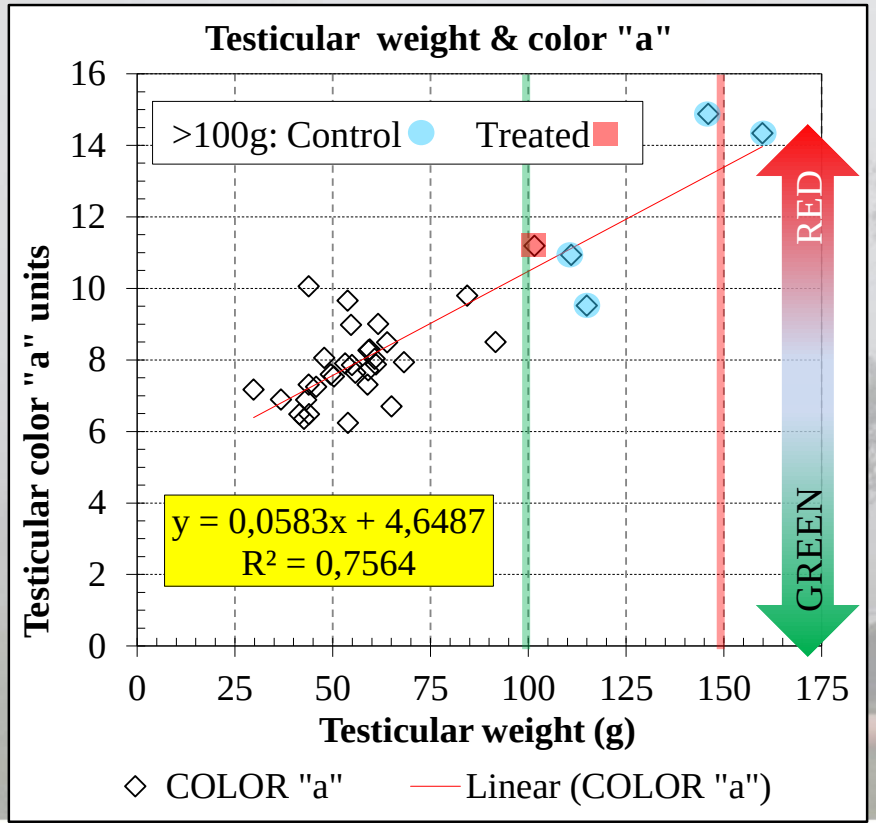
- Association between blood **testosterone** and testicular weight followed the same patterns of our previous studies (but within the low ranges).



150 g threshold

- Good correlation between testicular *in vivo* (echography) and *post-mortem* volume measurements.



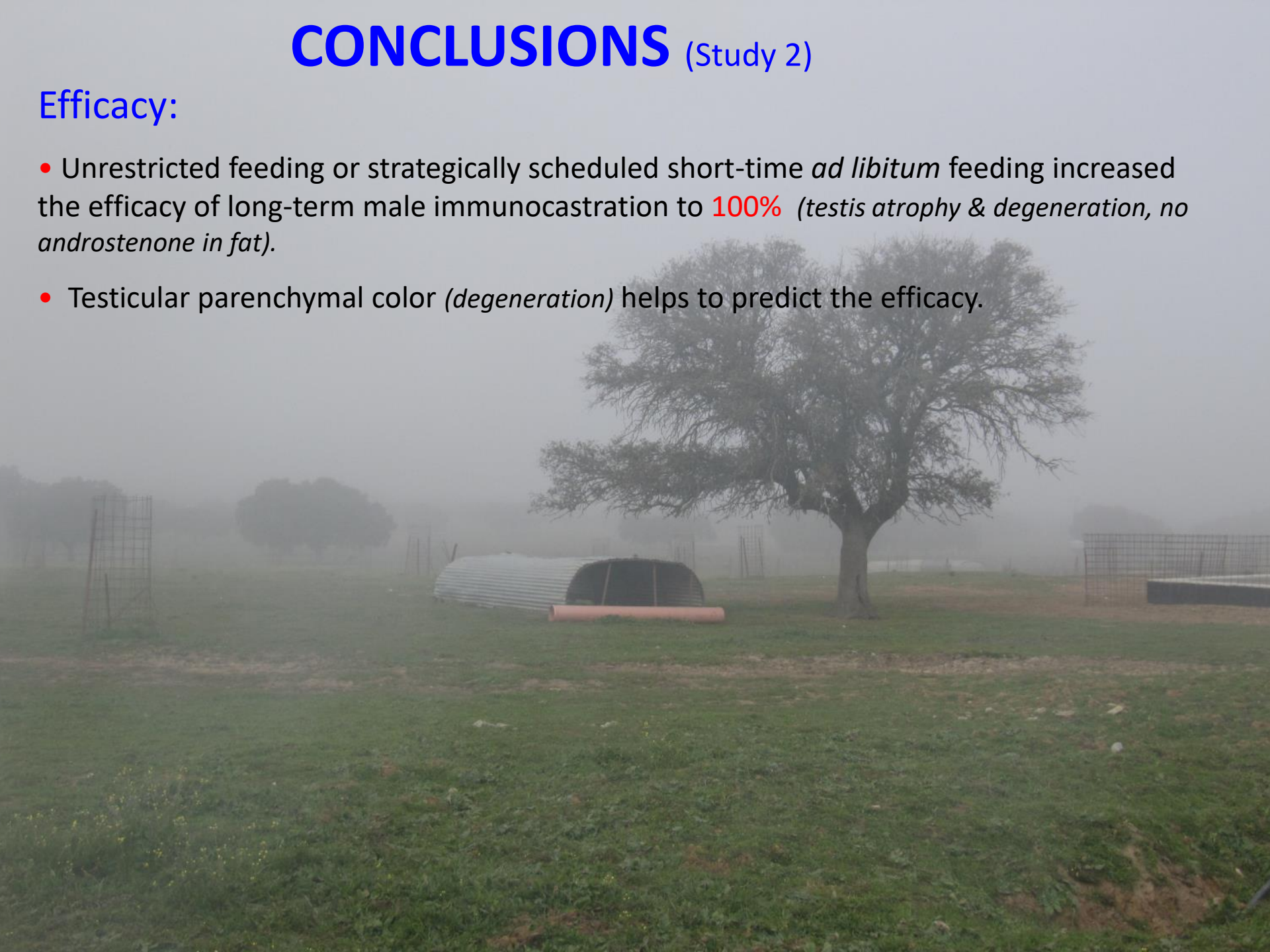


- Good correlation between testicular colorimetry and weight.

CONCLUSIONS (Study 2)

Efficacy:

- Unrestricted feeding or strategically scheduled short-time *ad libitum* feeding increased the efficacy of long-term male immunocastration to 100% *(testis atrophy & degeneration, no androstenone in fat).*
- Testicular parenchymal color *(degeneration)* helps to predict the efficacy.



GENERAL CONCLUSIONS (Studies 1 & 2)

Efficacy:

- Unrestricted feeding or strategically scheduled short-time *ad libitum* feeding increased the efficacy of long-term male late immunocastration to 100% (testis atrophy & degeneration, no androstenone in fat).
- Late immunocastration protocols can be compatible with *montanera* management system.
- Testicular parenchymal color *(degeneration)* helps to predict the efficacy.
- In contrast, the pre-pubertal protocol could not be improved by feeding management intervention (new research is being conducted to overcome this problem).

TEAM (CICYTEX)
F.I. Hernández-García
M. Izquierdo
M.A. Pérez
A.I. Del Rosario
N. Garrido
A. Montero.

Funding

TREASURE
Diversity of local pig breeds and production systems for high quality traditional products and sustainable pork chains

INIA
Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria

FEDER

Collaboration

IRTA
RECERCA I TECNOLOGIA AGROALIMENTÀRIES

zoetis