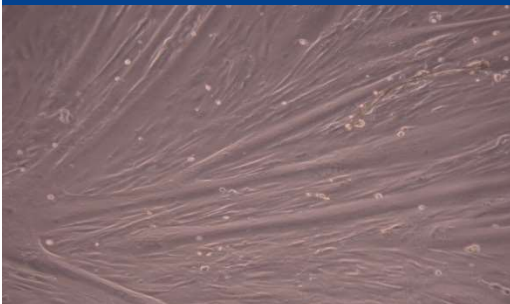


SUPPLEMENTATION OF L-ARGININE DURING GESTATION AND LACTATION OF SOWS AFFECT MUSCLE TRAITS OF OFFSPRING RELATED WITH POSTNATAL GROWTH BUT DEPENDENT ON BIRTH WEIGHT AND SEX: FROM CONCEPTION TO CONSUMPTION.

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A COLLABORATION BETWEEN ANIS AND FOOD,  
AARHUS UNIVERSITY, AND NUTRECO

N. OKSBJERG, M. THERKILDSEN, U. KROGH, P. KAPPEL THEIL, J. ASKOV JENSEN, H. SØNDERGAARD MØLLER, P. RAMAEKERS.



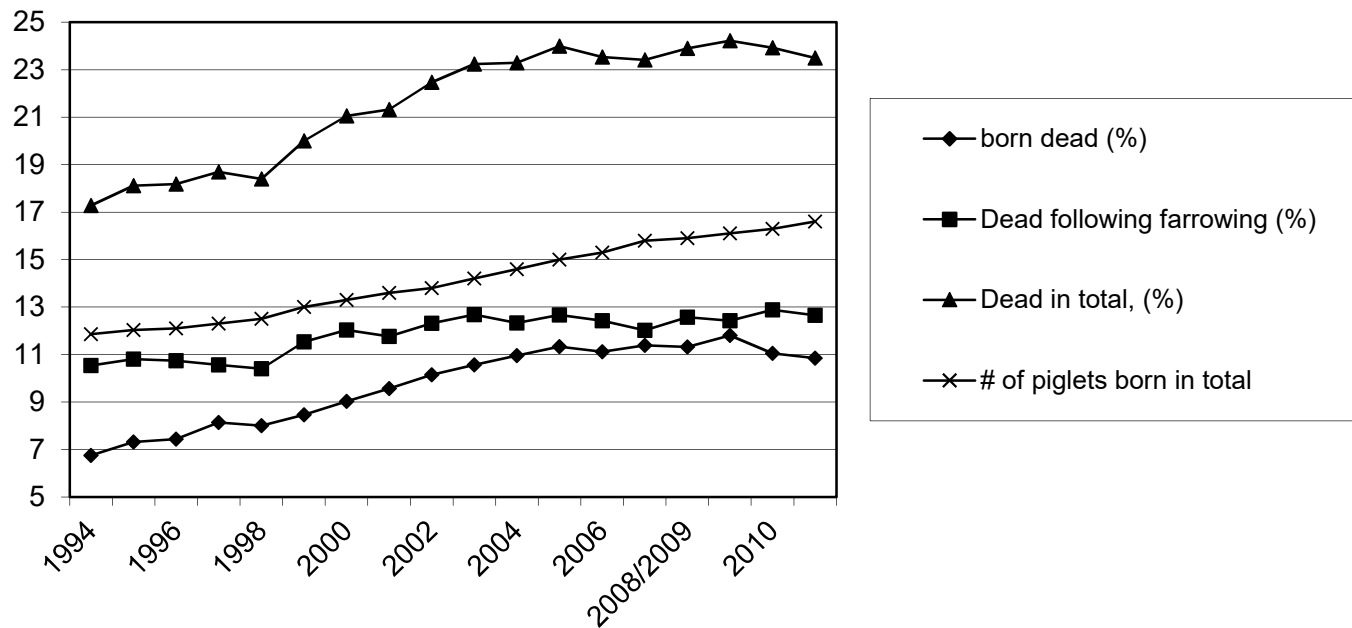
# INTRA-UTERINE GROWTH RESTRICTION (IUGR) CAUSES FETAL PROGRAMMING

- › Occur naturally in litter bearing animals like the pig
- › **Definition** = Impaired growth during embryonic and foetal growth, resulting in low birth weight
- › **Poor nutrition** is a major determinant caused by placental inefficiency
- › **Consequences** of littermates being born small
  - › Low survival rate (mean litter size is 16, 2 are born dead and 2 dies before day 5)
  - › Reduced growth performance
- › **In man** IUGR causes programming of metabolism resulting in type 2 diabetes
- › **The link** between low birth weight and performance is a reduction in the number of muscle fibres and changes in fibre cross-sectional area



### Development in number of pigs born in total and percentage dead in total per litter.

Percentage/# of piglets

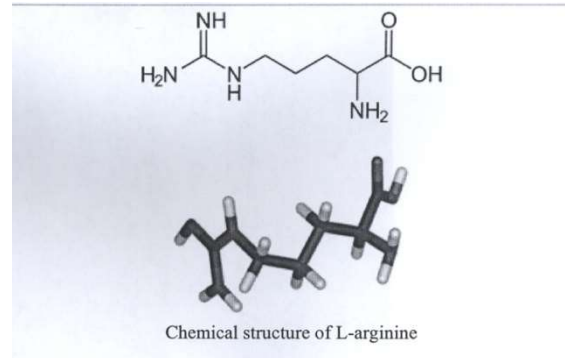


Year

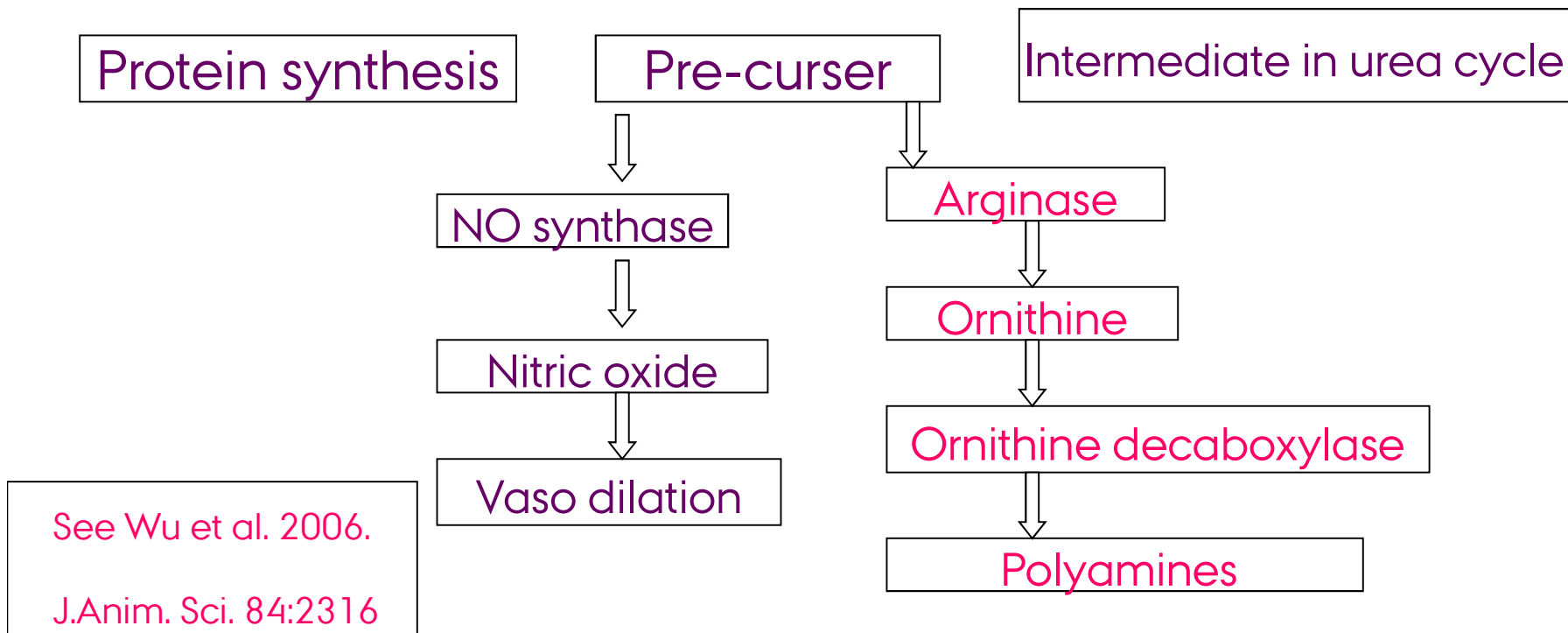
# FICK'S PRINCIPLE

Nutrient uptake = Blood flow x (A-V)





## PHYSIOLOGICAL ROLES OF L-ARGININE



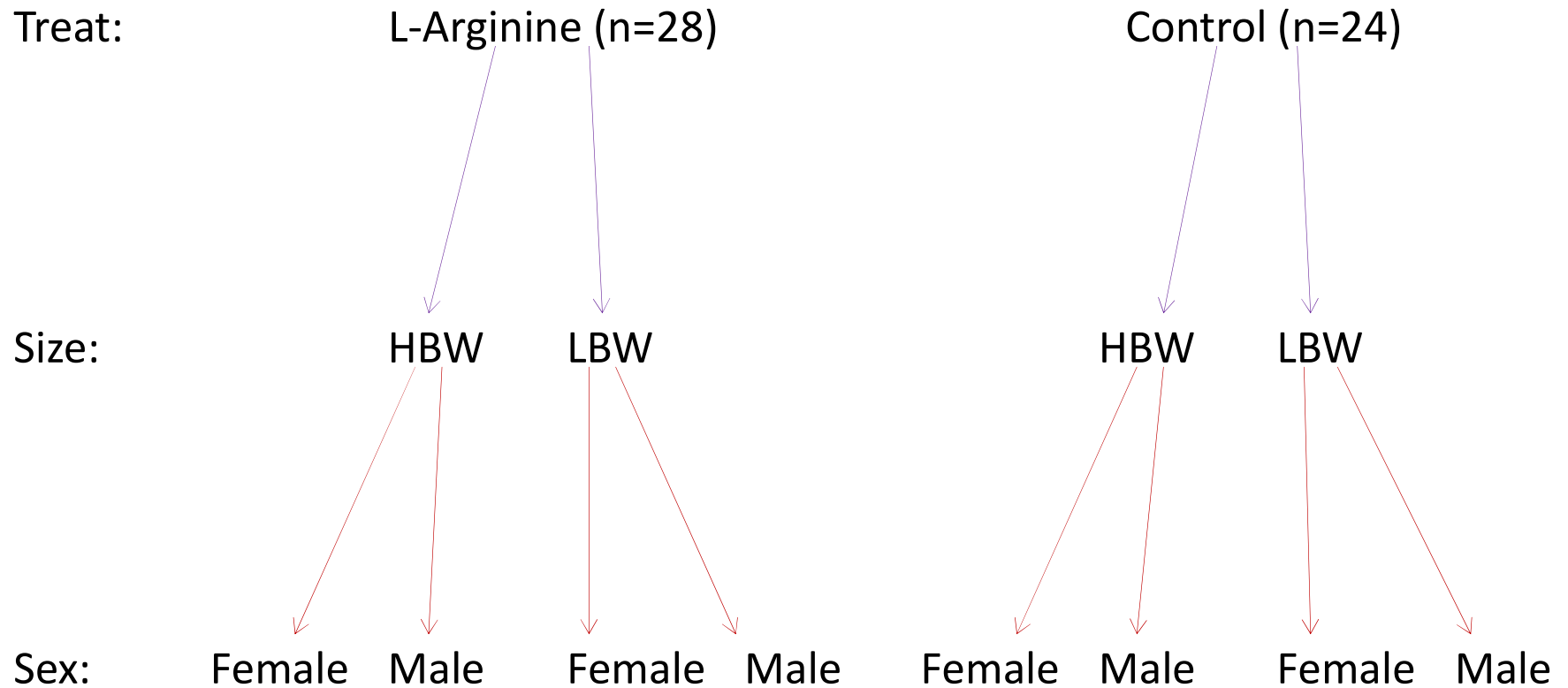
## OBJECTIVES ARE

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> To study the effect of maternal L-arginine (25 g/day) from day 30 to weaning on:

1. Performance
2. Muscle fibre number
3. satellite cell behaviour
4. Muscle physiological traits
5. Meat Quality

## A 2 by 2 by 2 factorial design



25 g L-arginine (1%) per day, slaughtered at d 140 and sampled

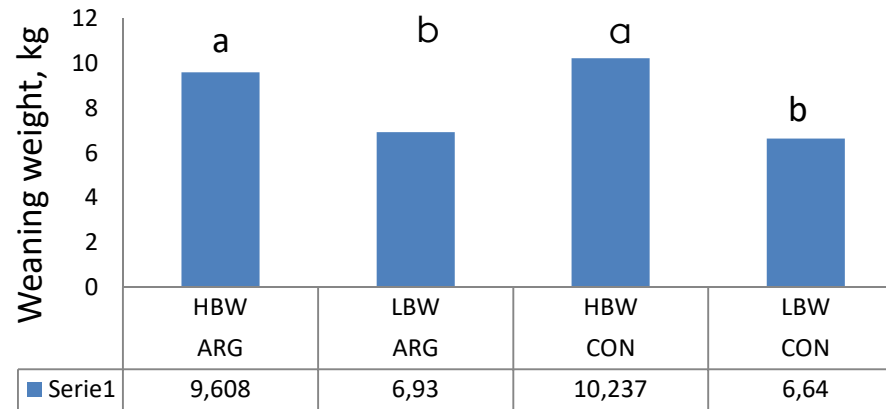
# LITTER SIZE

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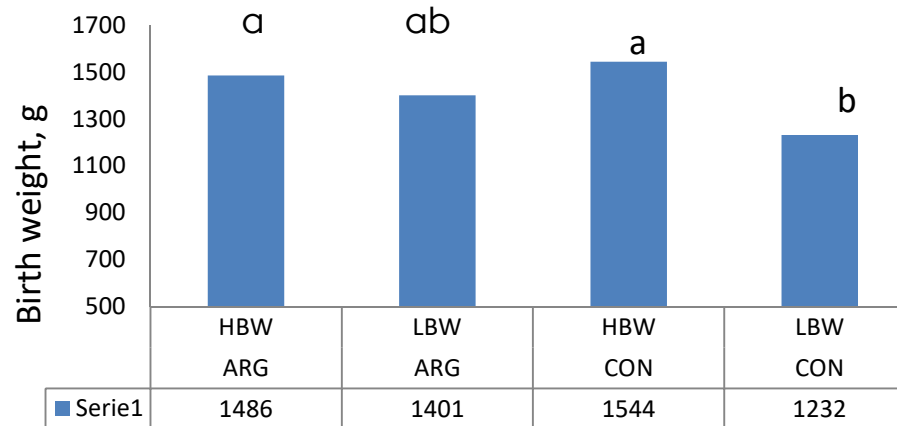
	ARG	CON
>		
>		
> Number born in total:	18.1	19.0
> Number born alive:	17.6	17.0

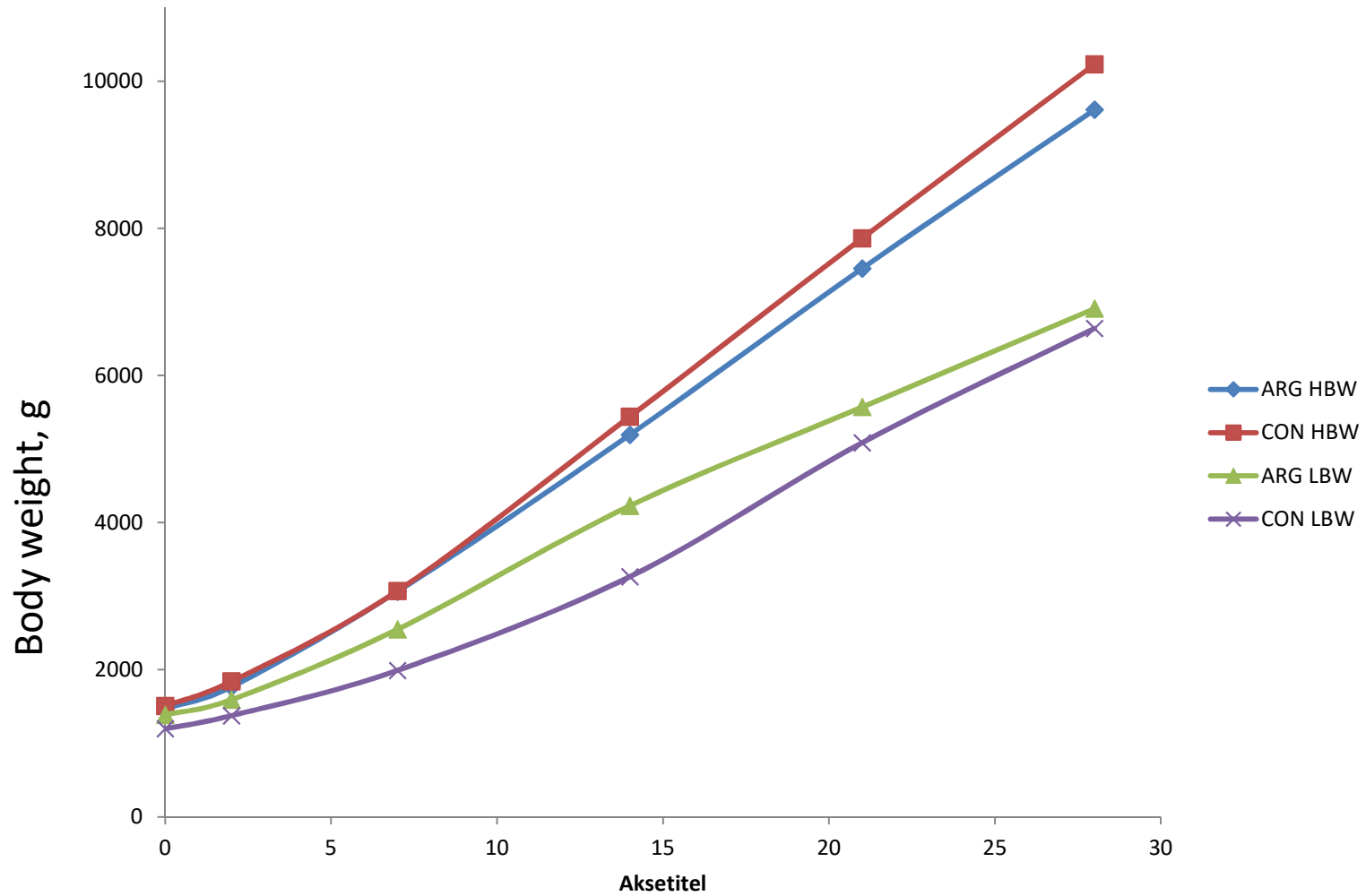


### LSMeans of TREAT by Size interaction on weaning weight



### LSMeans of TREAT by Size interaction on birth weight

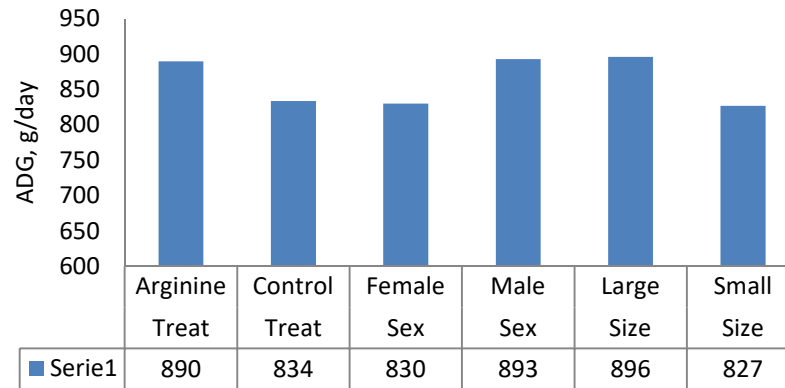




LSMeans of the main factors of TREAT, Sex  
and Size on daily gain g/day

PRESENTATION TITLE  
AUTHOR NAME  
AUTHOR TITLE

20 DECEMBER, 2008



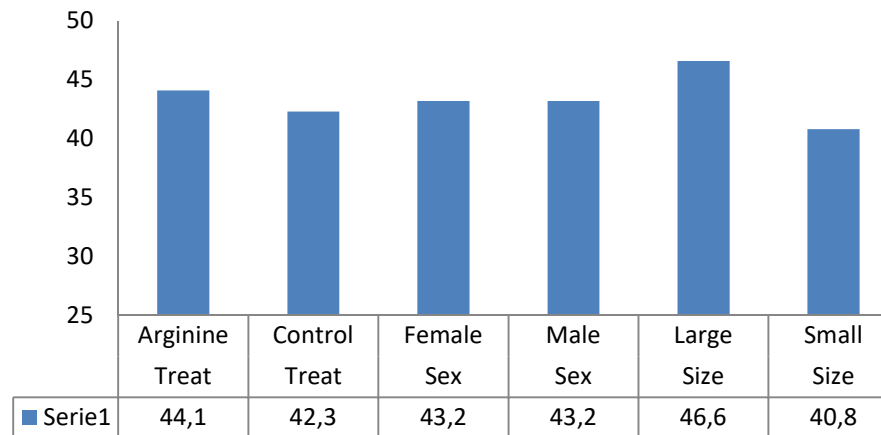
Treat: P<.02

Sex: P<.004

Size: P<0.002

No interactions

LSMeans main factors of TREAT, Sex, and Size on  
the CSA of Semitendinosus, cm<sup>2</sup>



Treat: P<.058

Sex: P NS

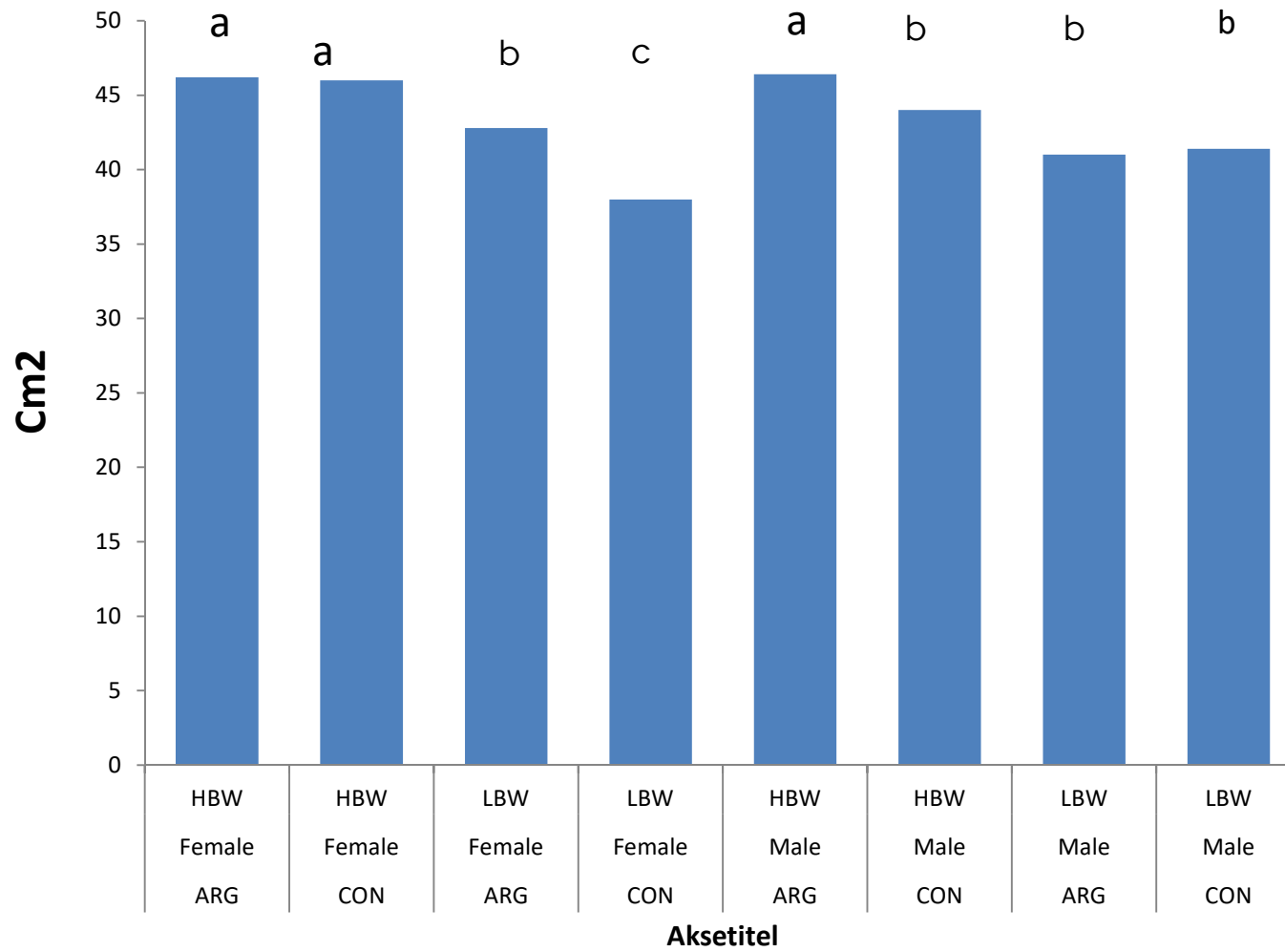
Size: P<.0001

3-way interaction,

P<0.001



LSMeans to TREAT by SIZE by SEX interaction on CSA of ST, cm<sup>2</sup>  
3-ways interaction (P<.001)



- 
- › Muscle growth = Muscle fibre number and cross-sectional area of muscle fibres
  - › and
  - › Muscle fibre cross-sectional area supported by satellite cell proliferation

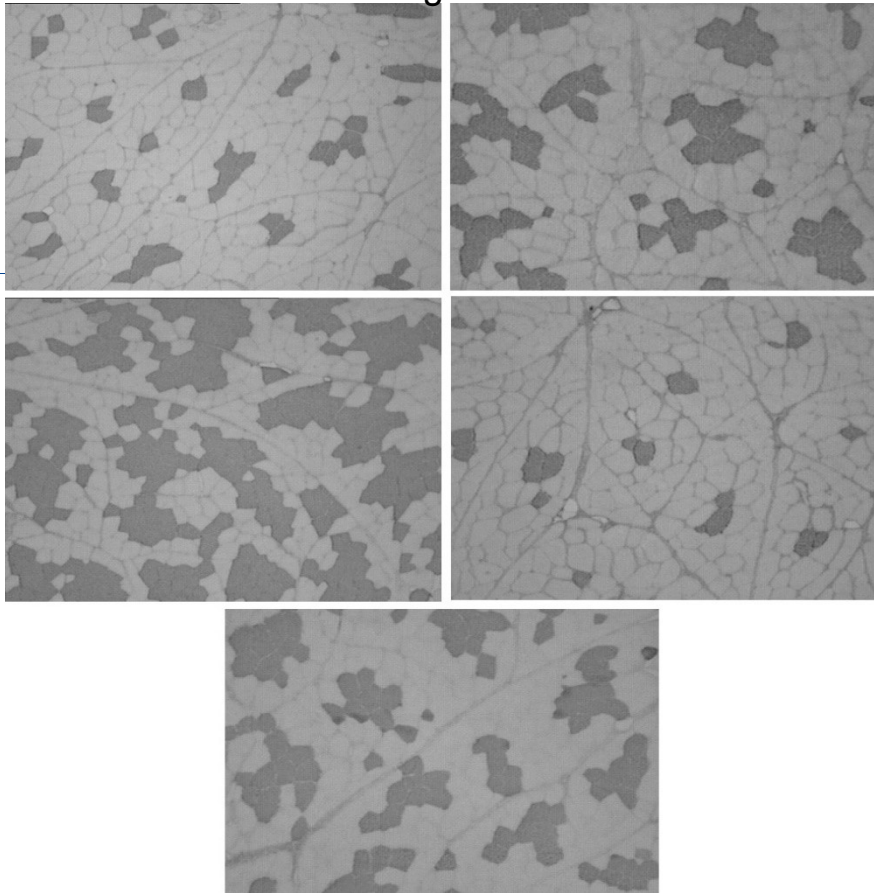
## MEASURING MUSCLE FIBRE NUMBER IN AN INDICATOR MUSCLE (PIG – SEMITENDINOSUS, ST)

- The cross-sectional (CSA) of ST is measured.
- Five samples are taken in the cross-section of ST
- Histochemical analysis for frequency of fibre types, and CSA of muscle fibres are measured.



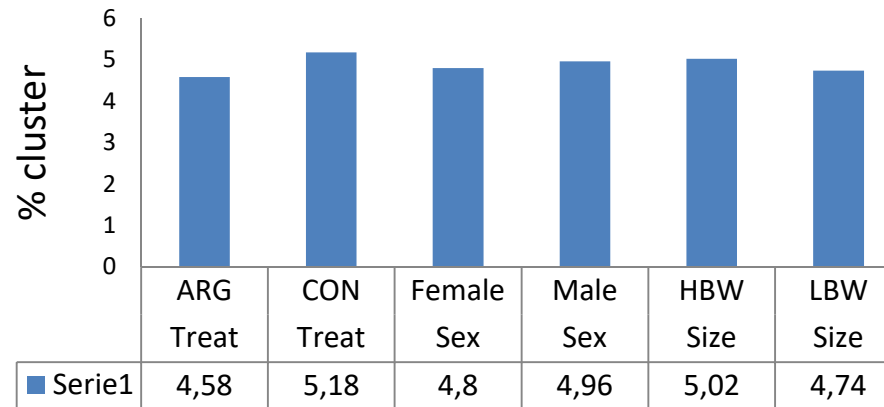
# ESTIMATION OF P AND S-FIBER NUMBER IN SLAUGHTER PIGS

Pig



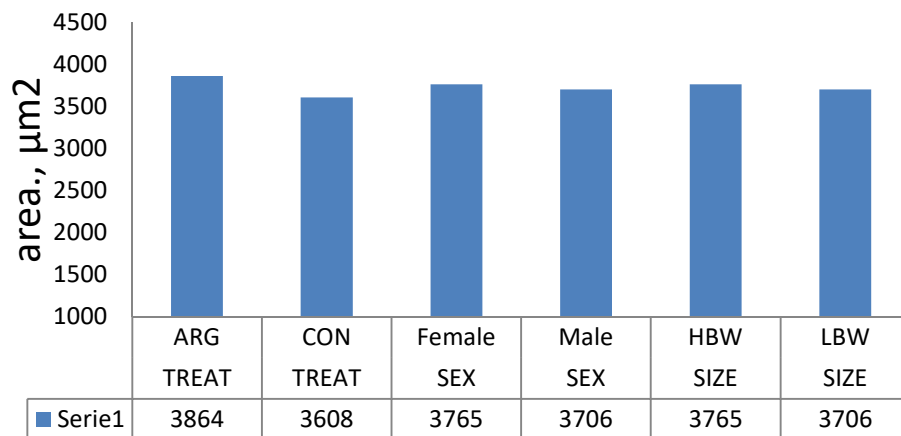
- Calculating muscle fibre number:
- Total fibre number (TNF) = Area of muscle / mean fibre area (MFA)
- Number of P-fibre =  $TNF * \% \text{ type I cluster}$
- Number of S-fibre =  $TNF - P\text{-fibre}$

### LSMeans for main effects of TREAT, SEX, and SIZE on % clusters

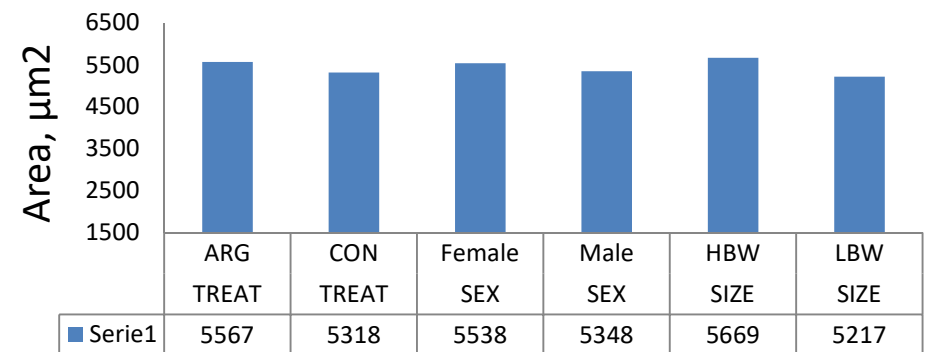


No main effects on type I  
in number .

### LSMeans TREAT, SEX and SIZE on *mean cross-sectional area of type I fibres*



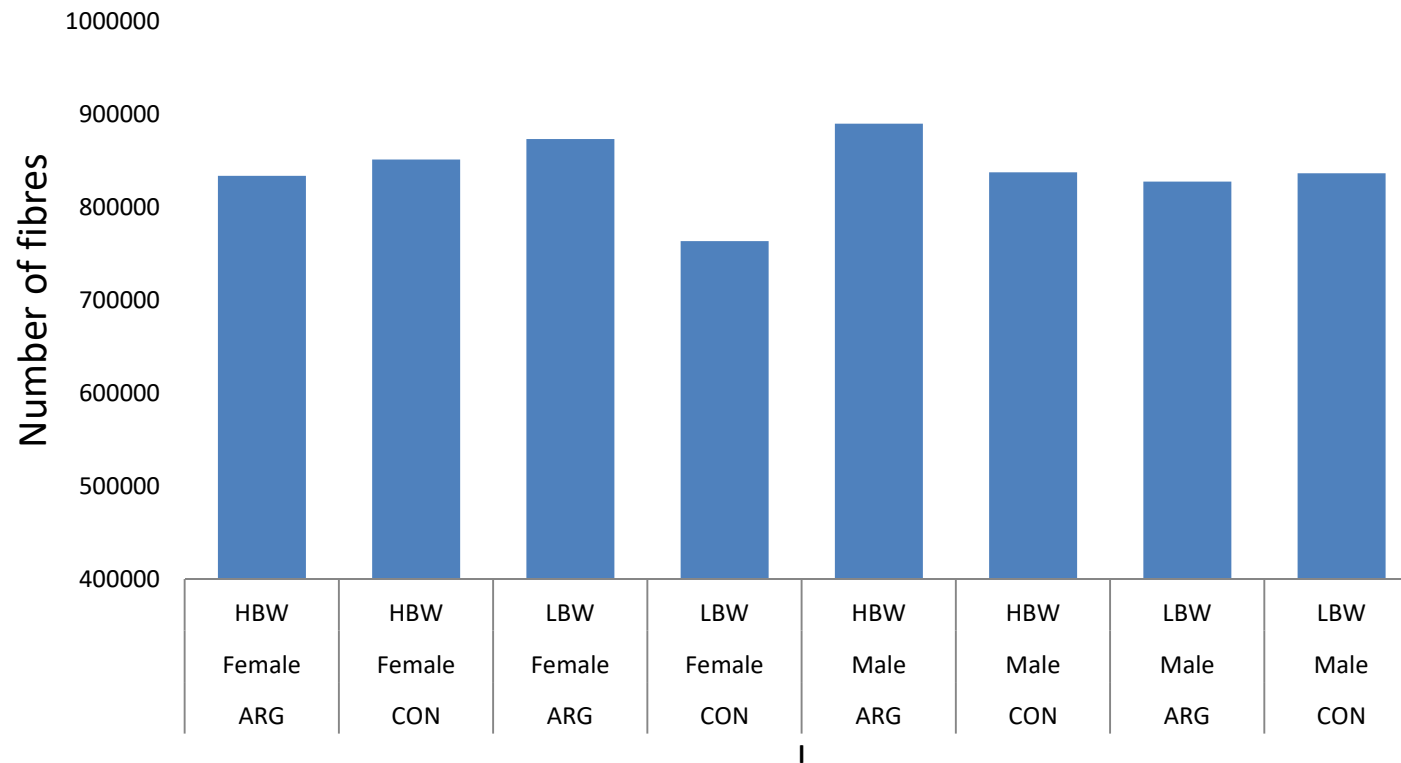
### LSMeans for TREAT, SEX and SIZE on mean cross-sectional area of type II fibres (Size, P<0,05)



Main effect of SIZE, P<0.01



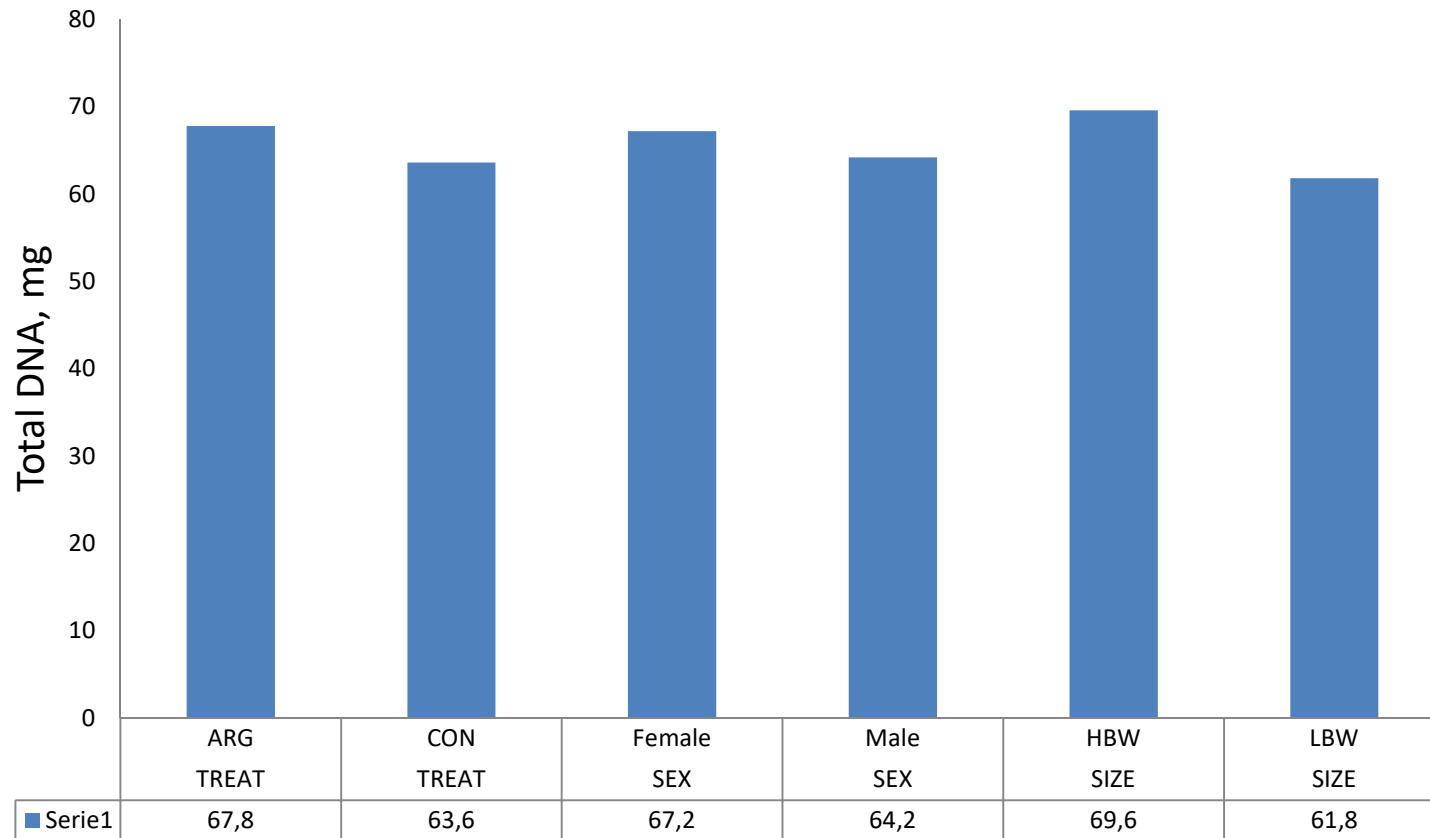
LSMeans to TREAT by SIZE by SEX on the number of S-fibre  
(3-ways interaction:  $P < 0.076$ )



- 
- › Total muscle DNA (Satellite cell proliferation)
  - › 70-80% of muscle DNA present at slaughter originate from satellite cell proliferation. Thus, a change in DNA may imply a change in satellite cell proliferation.

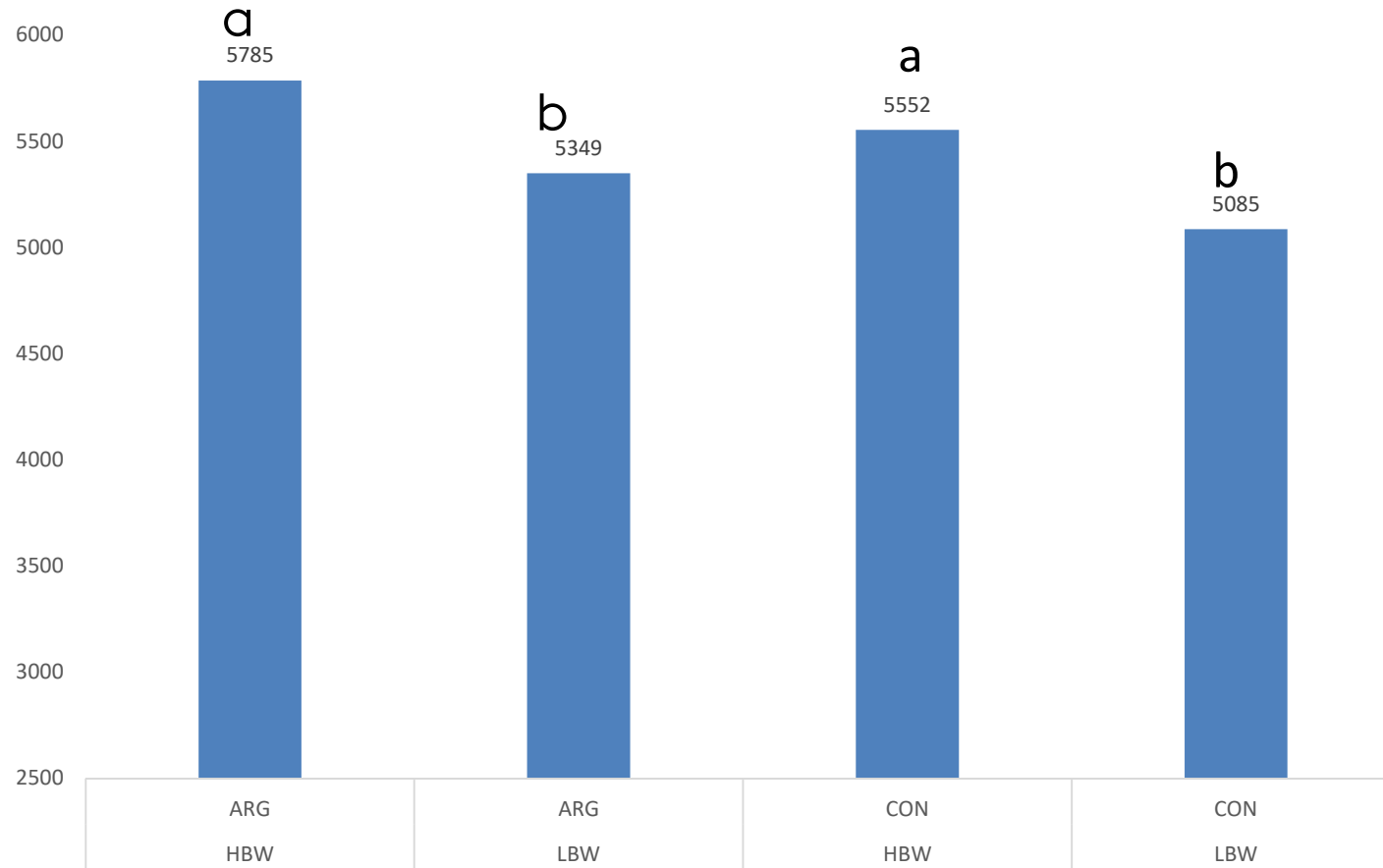


## Main effects of Treatment, Sex and Size on total DNA

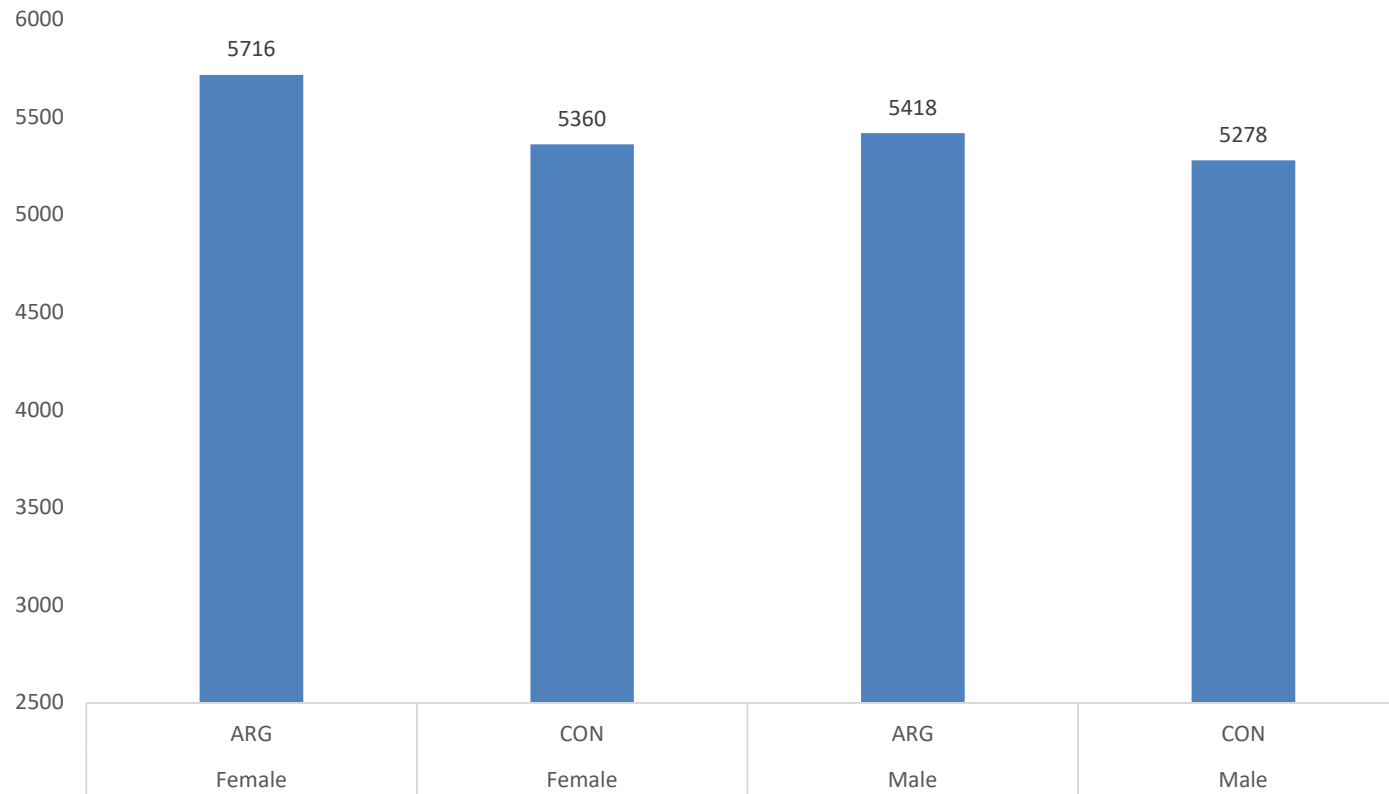


Treat:  $P < 0.3$ ; SEX:  $P < 0.02$ , Size:  $P < 0.0001$

LSMeans to the 2-way interaction between TREAT and SIZE on muscle fibre area of type II fibres



LSMeans of the 2-way interaction of TREAT and SEX on  
mean fibre area,  $\mu\text{m}^2$ .



# MEAT QUALITY

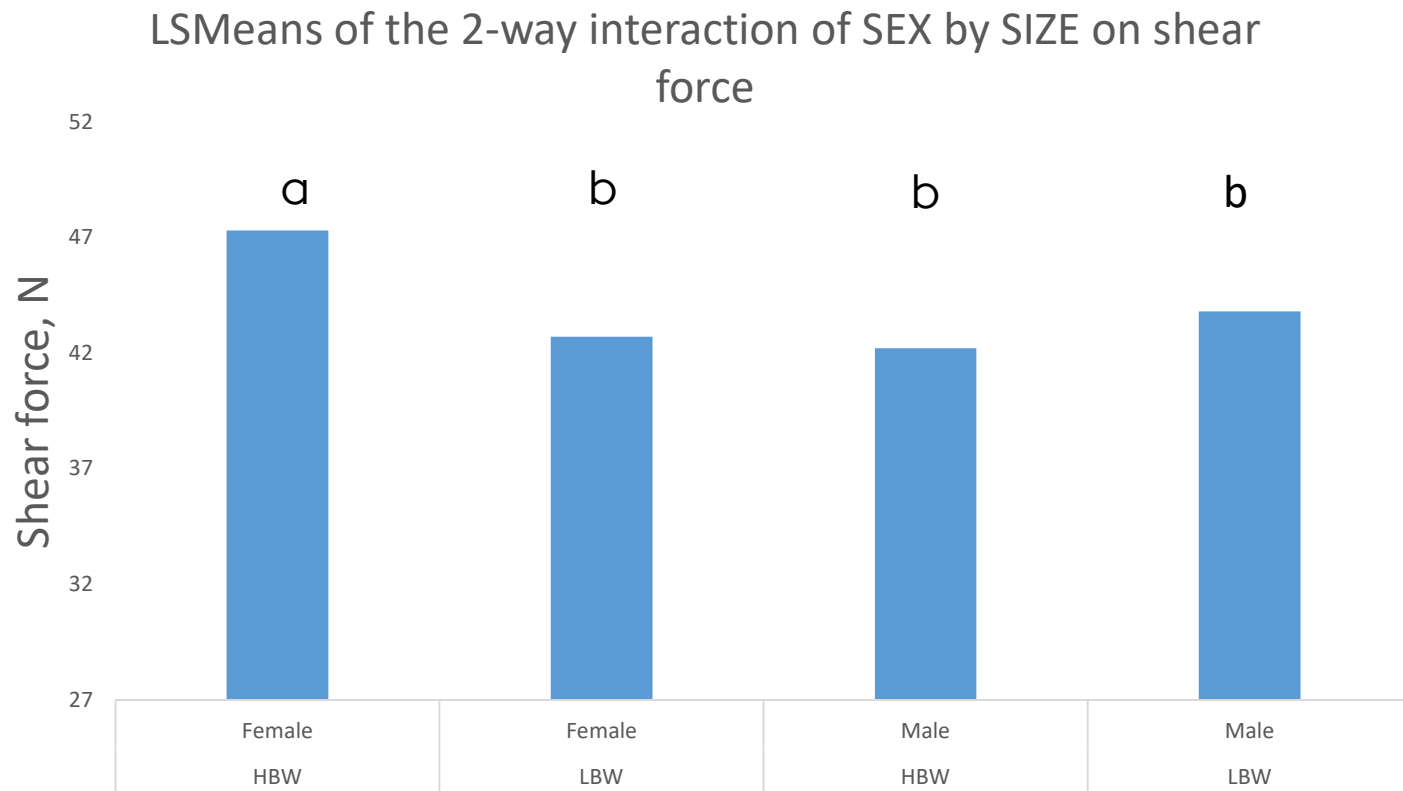
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- › pH45,
- › pH24,
- › Cooking loss,
- › Thawing loss
- › Shear Force
- › Myofibrillar Fragmentation index (MFI)

# PHYSIOLOGICAL TRAITS

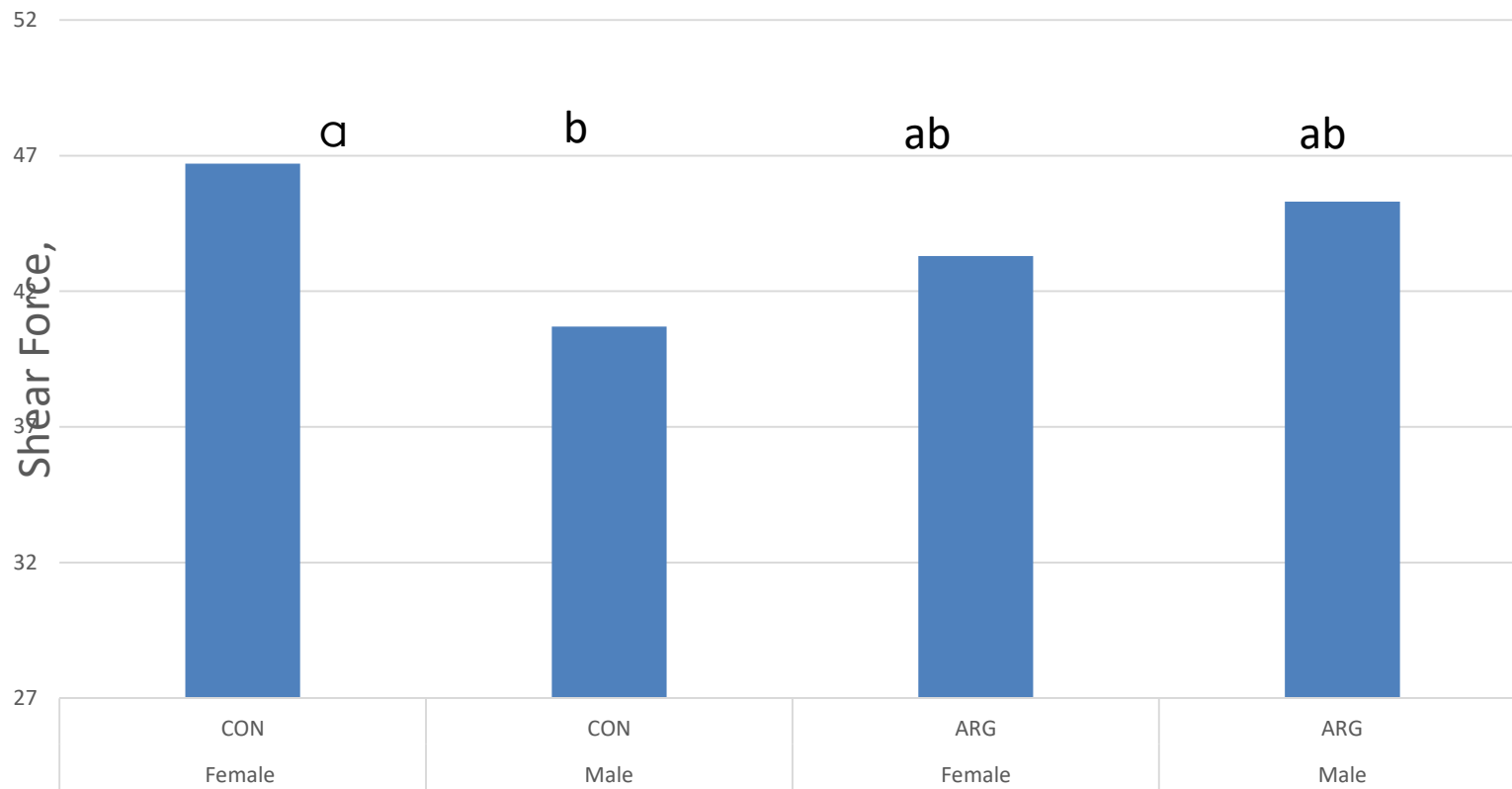
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- › Pro-glycogen
- › Macro-glycogen
- › CS (citrate synthase)
- › HAD
- › LDH      LDH was increased in ARG offspring





### LSMeans of the interaction between TREAT and SEX on shear Force



## CONCLUSIONS:

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- › Addition of ARG during gestation and lactation increased postnatal daily gain and cross-sectional area of semitendinosus in offspring female and male pigs.
- › With respect to CSAST, LBW female pigs responded, while in castrated pigs the HBW piglets responded.
- › Regarding the muscle traits, the sex of the pigs also responded differently in that female pigs had increased muscle fibre number and increased total muscle DNA.
- › These muscle traits reflecting muscle growth, was not changed in castrated male pigs.
- › Meat quality traits, especially the shear force seems to be programmed during gestation.