Martin Luther University Halle-Wittenberg
Institute of Agricultural and Nutritional Sciences (IANS)
Animal Breeding

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Session 10.5 "Tail biting and feather pecking", Aug 26th, 2019

Genetic analyses of birth weights, tail measurements and scores for tail anomalies in pigs

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Introduction

- Tail biting in pigs is a continuing problem
- Tail docking is a welfare issue
- Short tails would be desirable
- **Objective:**
    - collect data on tail lengths in piglets
    - jointly collect data on:
        - tail diameter
        - body length of animals
        - anomalies
        - birth weights
- genetic - statistical analysis

Data collection (1)

- Purebred Piétrain line of BHZP GmbH
- Pi x (DE x DL) cross an commercial piglet producer farm

Animals	Piétrain	Pi x (DE x DL)
no. of piglets	6428	822
no. of litters	582	63
no. of sows	410	63
no. of boars	67	6
no. of visits	17	3

- Data recording:
  - on day 1/2 after birth (Pi)
  - on day 3/4 for Pi x (DE x DL)

Data collection (2)

- **Sow data** (litter no., no. of teats, EBV, date of insemination)
- **Litter data** (total born piglets, piglets born alive, no. male, no. female)
- **Piglet data:**
  - ID, sex, age
  - length of tail
  - tail diameter
  - body length
  - individual weights
- **Tail anomalies**

Data collection (3)

Piglet data

- **Tail anomalies:**
  - normal
  - bend << 90° => light
  - bend around 90° => medium
  - bend >> 90° => severe

Data collection (4)

Piglet data

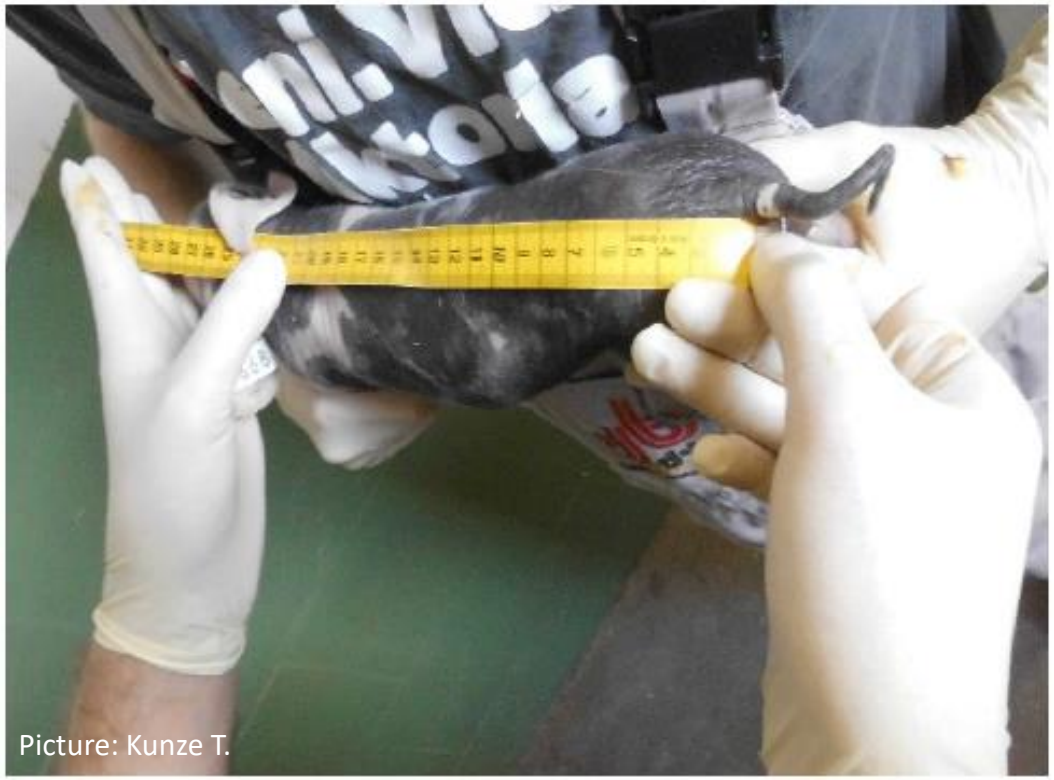
Tail measurements

Length of tail

Tail diameter

Data collection (5)

Piglet data



Body length

Individual weights

Statistical models

I Fixed Model

y = μ + Litter + visit_date + X + covariate + residual

y =	X	Covariate Body length	Covariate weight	Covariate Tail length
Tail length	anomalies yes/no	yes	no	no
Tail diameter	-	no	yes	no
Weight	sex	yes	no	no
Body length	-	no	yes	no
Anomalies	-	no	no	yes

Statistical models

II Mixed Model

- **as fixed model, including random effects:**
  - animal additive genetic
  - maternal genetic and
  - litter effect

III Threshold model (univariate) for trait Anomalies yes/no

- **Logit link function**
  - animal additive genetic effect

Results

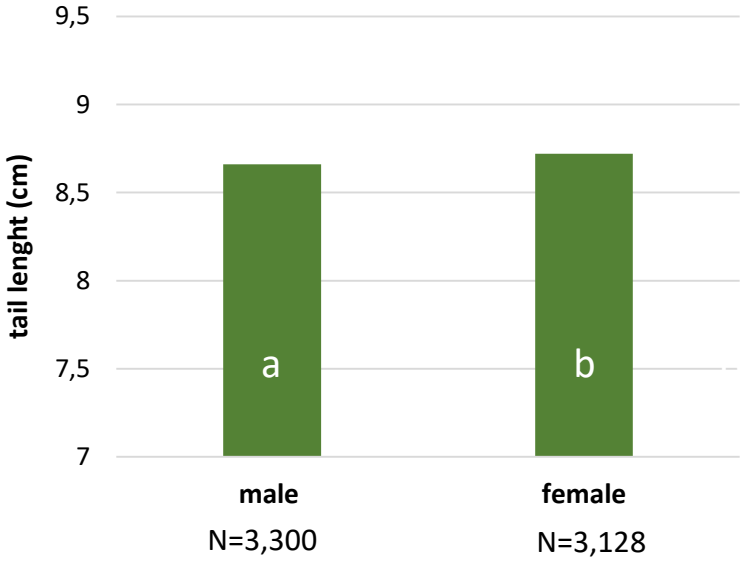
- **Raw means of piglet traits (Piétrain)**

Piglet traits	no.	mean	SD	Min	Max
Tail length (cm)	6,428	8.69	0.99	4.10	12.50
Tail diameter (cm)	6,428	0.79	0.09	0.40	1.20
Body length (cm)	6,428	27.43	2.40	16.50	35.50
Weight (kg)	6,426	1.46	0.36	0.51	2.60

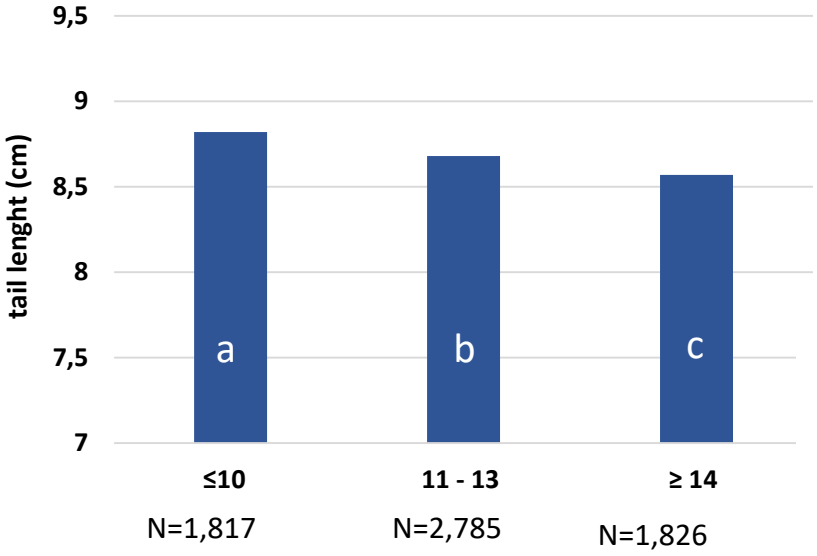
Results

Descriptive statistic - Tail length of piglets

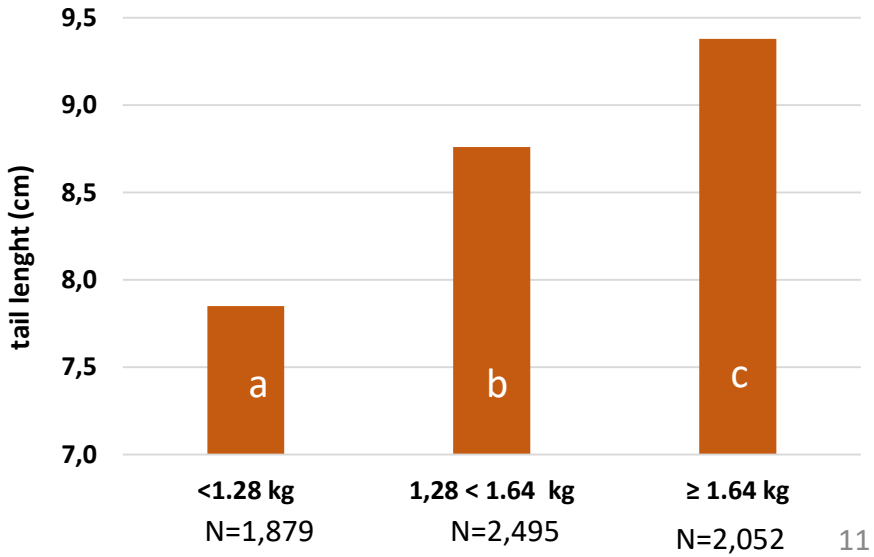
Depending on sex of piglets



Depending on the no. of total born piglets per litter



Depending on birth weight of piglets



Results

Factors influencing the tail length of piglets

- **Effect of litter no., visit date and anomalies:**
  - Litter no. effects and visit date had little influence
  - Tail without anomalies: 8.73 cm
  - Tail with anomalies: 7.99 cm

Picture: Kunze T.

Results

Estimates of heritabilities and correlations

Direct heritabilities, **genetic** and **phenotypic correlations** (N=6,419)

Piglet traits	Tail length	Tail diameter	Body length	Birth weight
Tail length	**0.306**	**0.60**	**0.42**	**0.41**
Tail diameter	0.64	**0.122**	**0.48**	**0.59**
Body length	0.70	0.58	**0.177**	**0.87**
Birth weight	0.68	0.69	0.81	**0.043**

Results

Estimates of heritabilities and correlations

Maternal heritabilities and genetic correlations (N=6,419)

Piglet traits	Tail length	Tail diameter	Body length	Birth weight
Tail length	0.073	0.93	0.96	0.99
Tail diameter		0.057	0.82	0.91
Body length			0.095	0.97
Birth weight				0.137

Results

Estimates of heritabilities and correlations

Proportion of litter variance/total phenotypic variance and genetic correlations

Piglet traits	Tail length	Tail diameter	Body length	Birth weight
Tail length	0.103	0.87	0.88	0.78
Tail diameter		0.086	0.84	0.80
Body length			0.113	0.86
Birth weight				0.160

Results

Tail anomalies

- **Heritability of tail anomalies**
  - Threshold model
  - only additive genetic effect considered
  - h^2= 0.343


Picture: Kunze T.


Picture: Kunze T.

Further results

- **Piglets with short tails:**
  - had lower birth weight
  - had lower average weight gain later in life

- **except for very short tails (< 7.0 cm)**
  - hardly any differences in fat and muscle measurements later in life

Results for Crossbred piglets on commercial farm

- Pi x (DE x DL) crosses

- EBV for boars from purebred (Pietrain) data only partially correlate with tail measurements of commercial crosses

  ➔ Results difficult to interpret as only six boars were used
  ➔ Tail length and diameter substantially influenced by birth weights
    ➔ birth weights were substantially higher in crosses and may mask the differences in tail measurements

  ➔ Non-additive genetic effects possibly play a role
  ➔ Further investigation is needed

Conclusion

- Tail length and tail diameter substantially influenced by birth weight
- Estimates of heritabilities show values of moderate magnitude
- Genetic correlations with birth weight are substantial
- Maternal heritabilities do not play a large role
- Anomalies of the tail partially have a genetic background, this will be followed in a genomic study of the data