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für Wirtschaft und Umwelt
Nürtingen-Geislingen



Infrared thermography in dairy goats to define health traits – preliminary results

S.A. Goth, M. Bernau

Florenz, 04. September 2024, Sara Alexandra Goth

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für Ernährung
und Landwirtschaft

Projekträger:



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aufgrund eines Beschlusses
des Deutschen Bundestages

Förderkennzeichen:
28N-2-035-01

Introduction

- health problems are an animal welfare issue, especially udder health & parasitic load
- how can health be measured directly on the animal in an objective manner?
- is there a possibility to use a non invasive technique?
- infrared thermographic measurements (ITM) are already used in several areas of animal science (Coşkun & Aytekin, 2021) and may help to identify differences (e.g. Schaefer *et al.*, 2007; Mota-Rojas *et al.*, 2021; Gayathri *et al.*, 2024)
- **the aim of this study is to evaluate whether infrared thermographic measurements can be used to describe health in dairy goats**

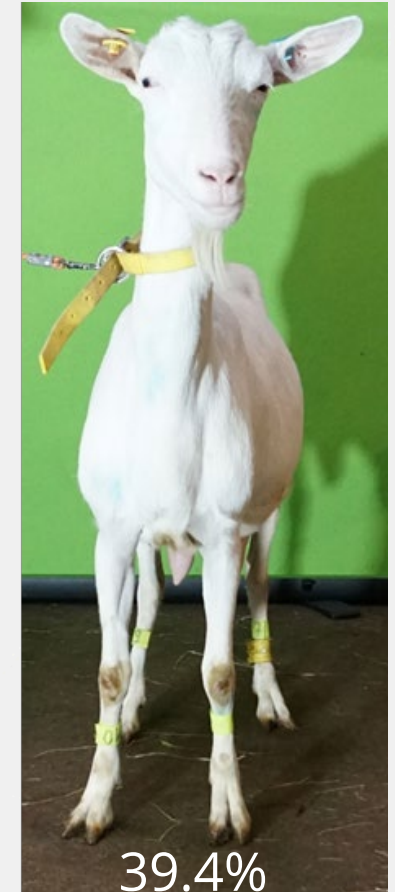
Animals & methods



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- 7 German dairy goat farms (conventional & biological)
- two different breeds
(german fawn goat and german white goat)
- 24 animals per farm were examined once
- resulting in 168 examined goats

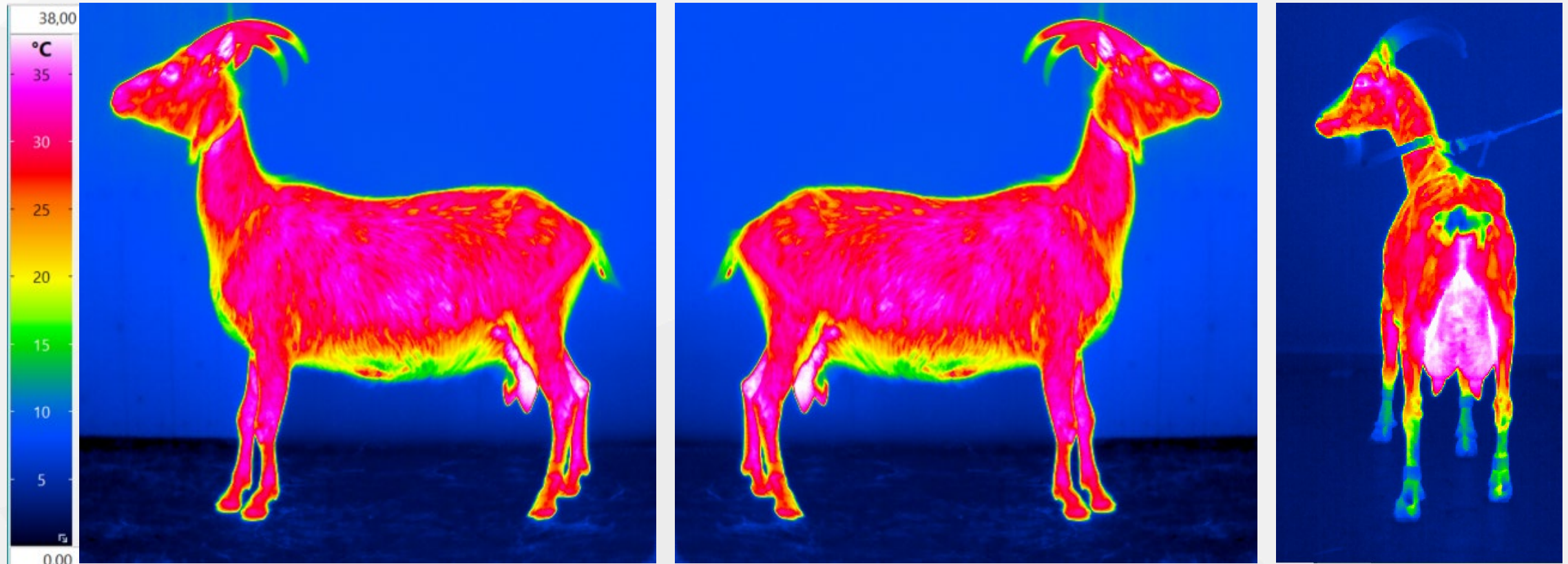


Animals & methods

Infrared thermographic measurements (ITM)



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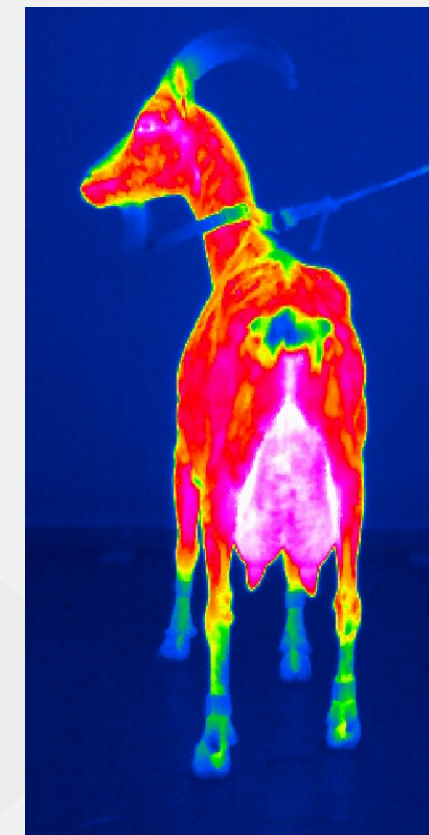
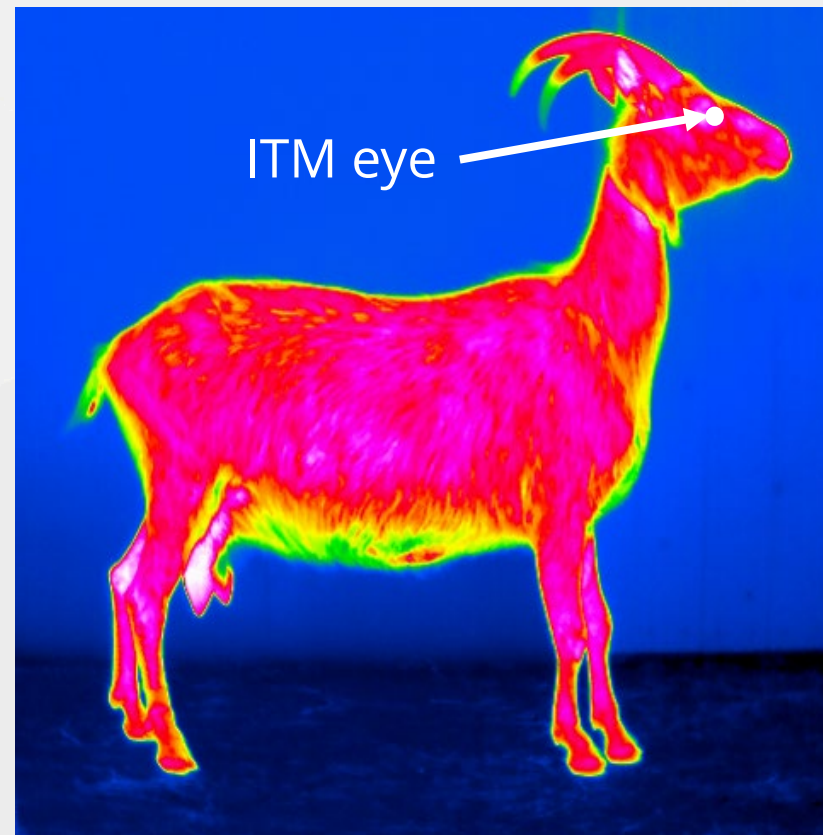
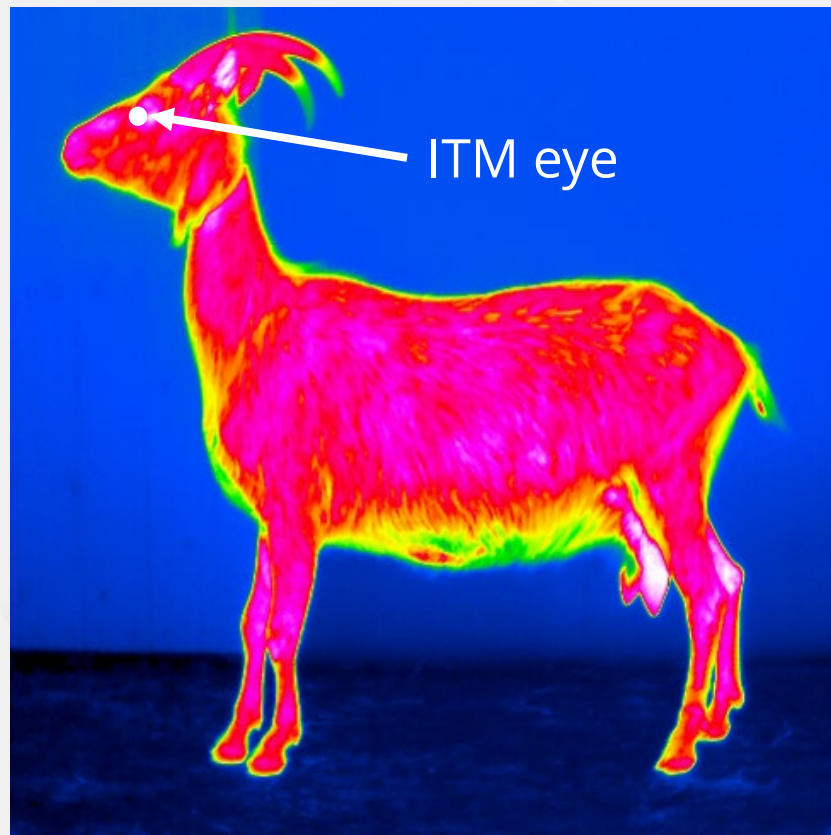
- VarioCAM® High Definition (HD) from InfraTec GmbH (Dresden, Germany)
- software IRBIS®3.1 plus from InfraTec GmbH (Dresden, Germany)

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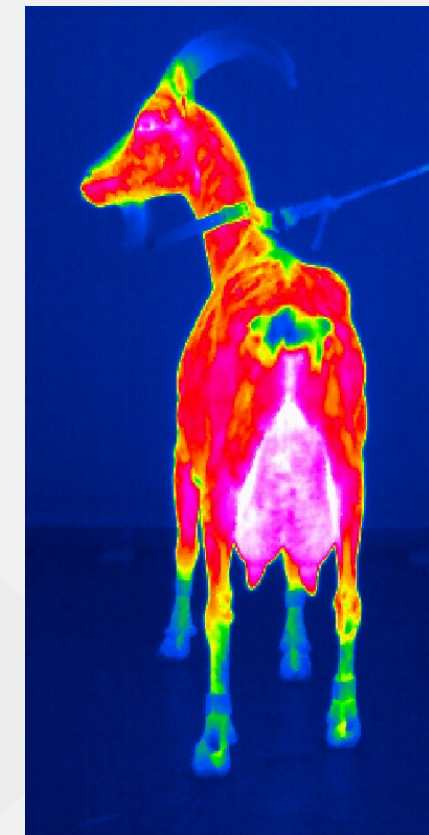
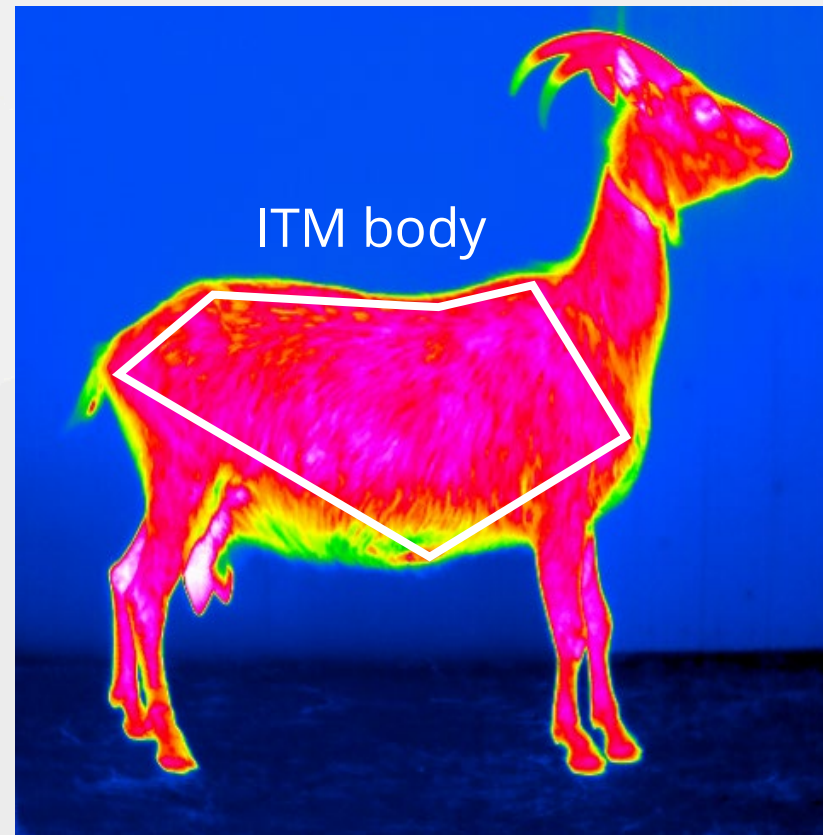
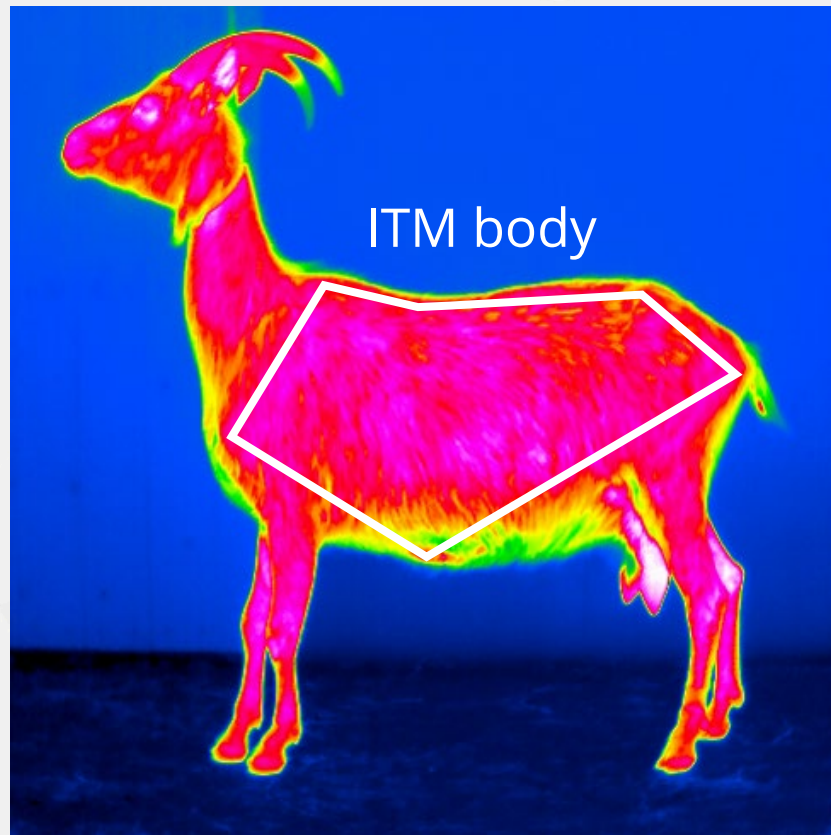


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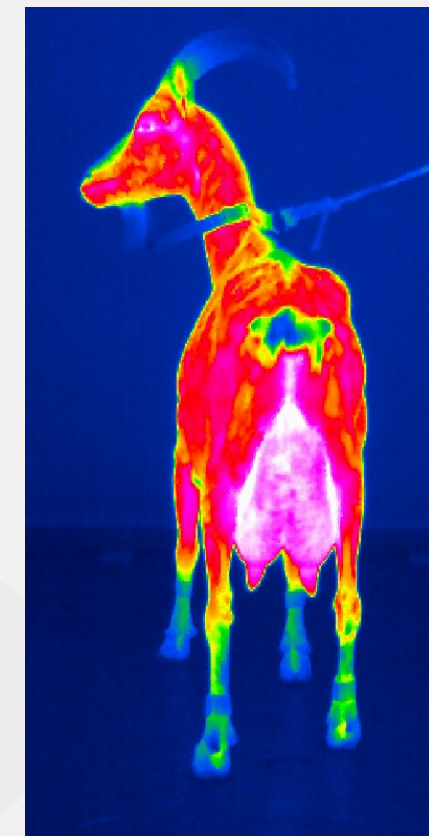
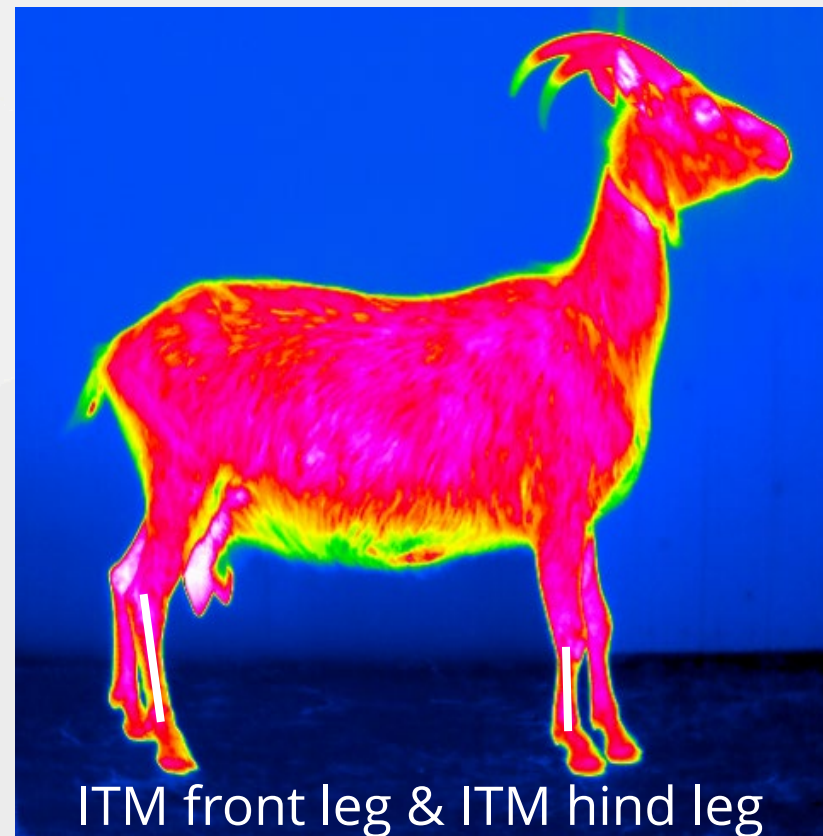
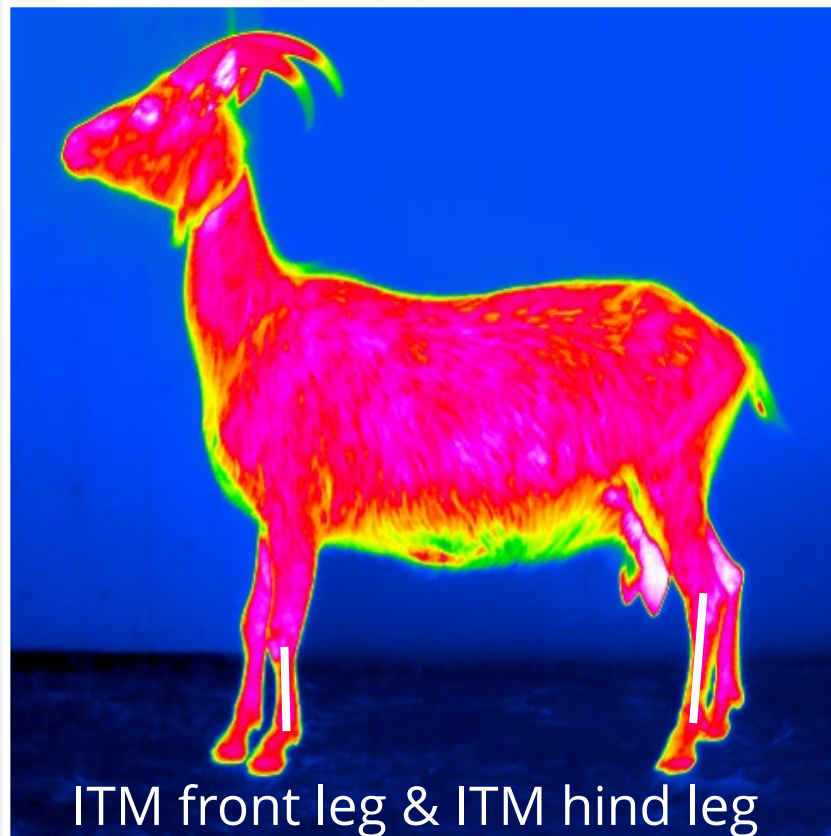


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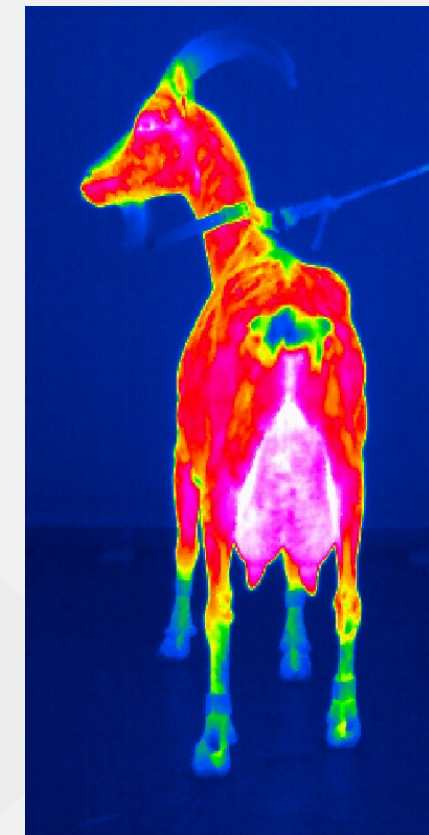
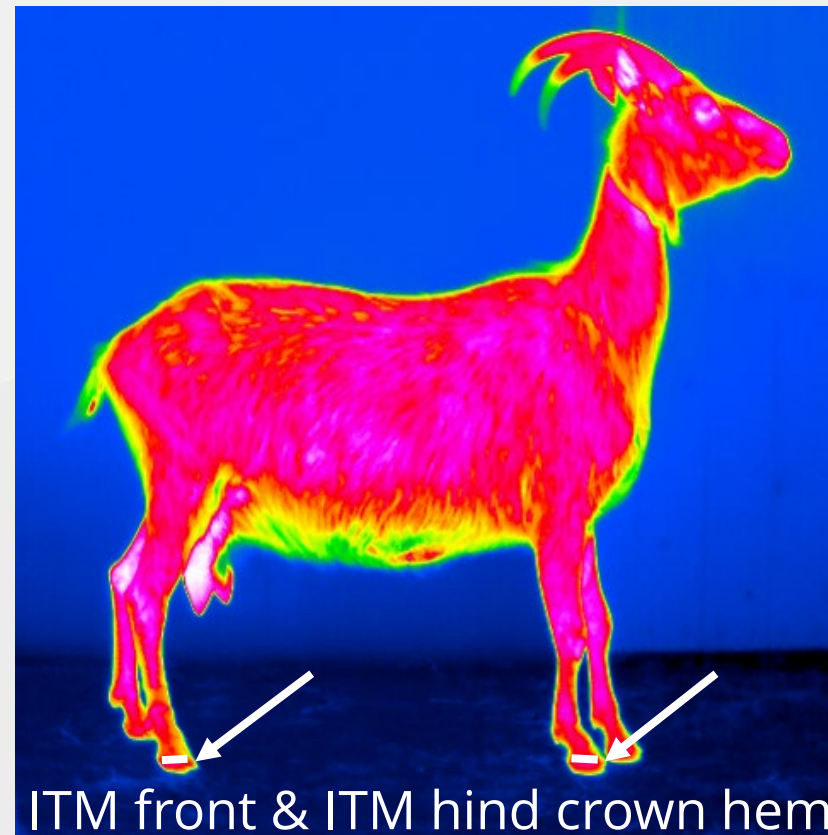
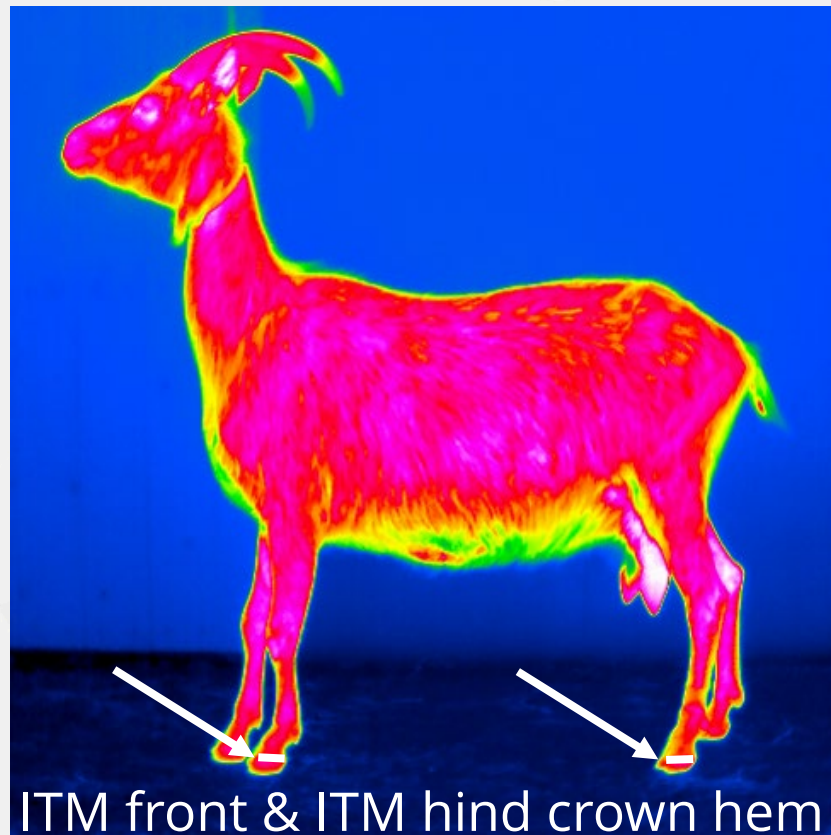


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Infrared thermographic measurements (ITM)



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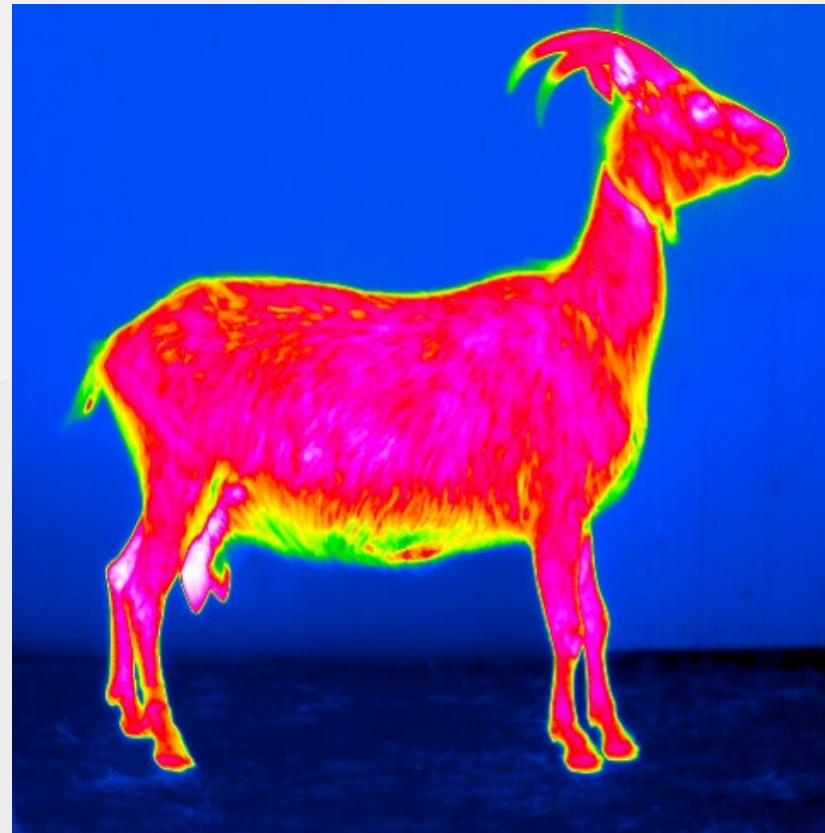
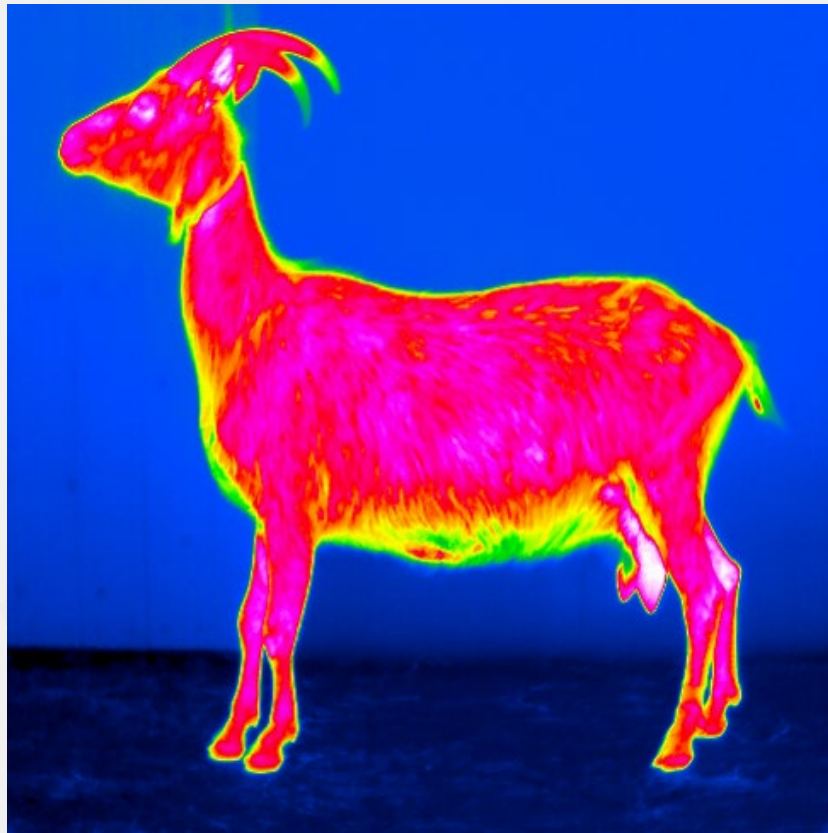


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Infrared thermographic measurements (ITM)



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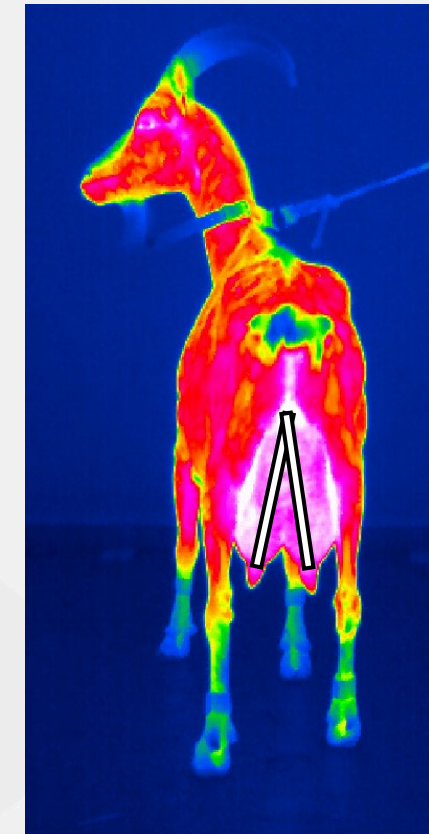
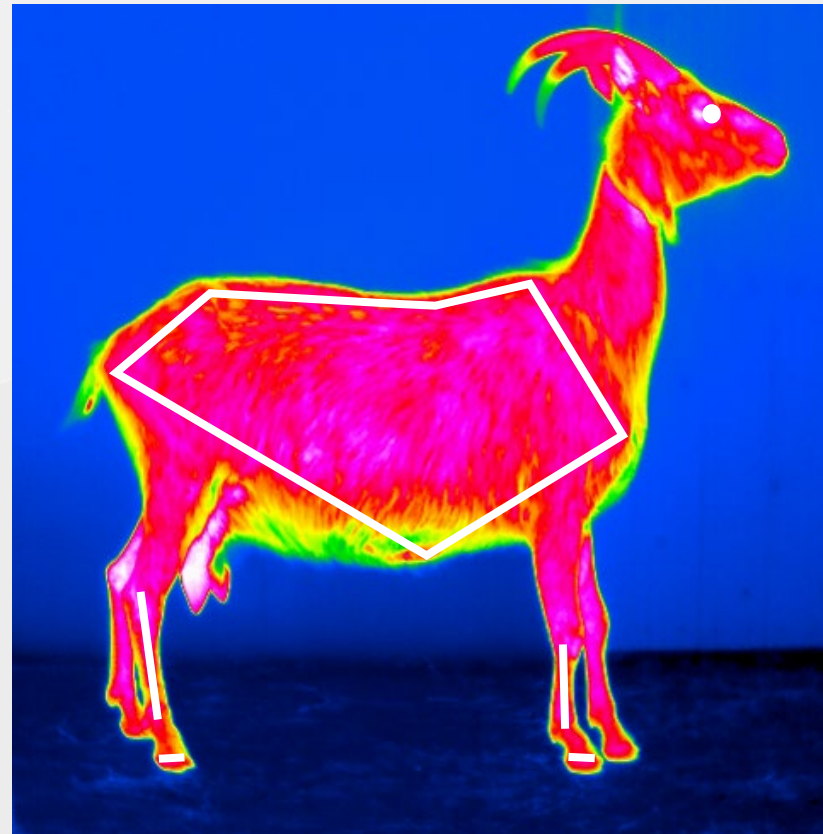
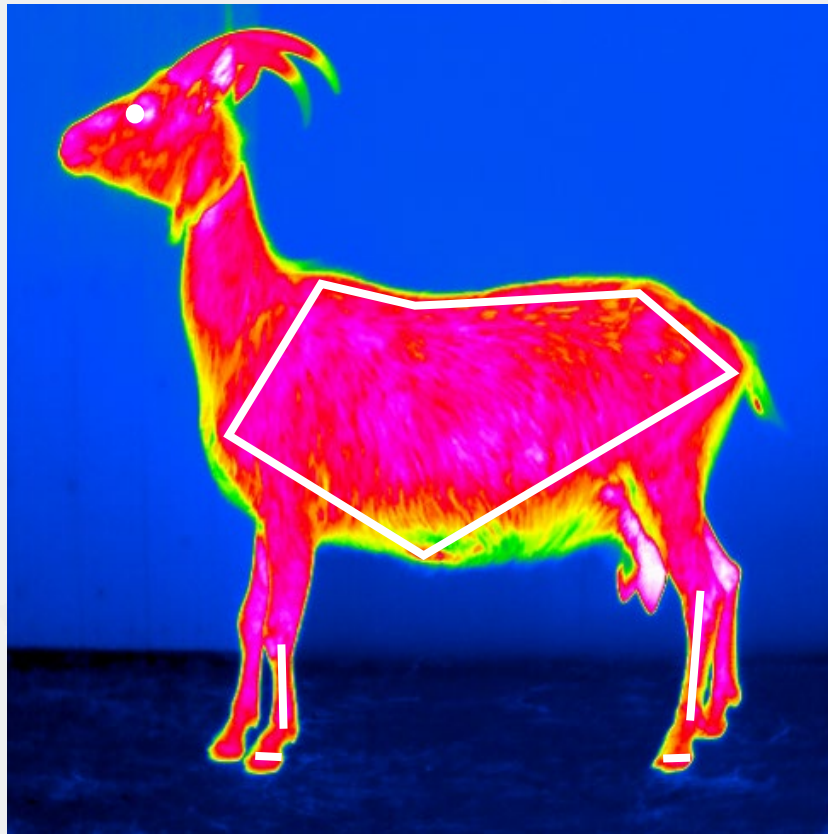


Animals & methods

Infrared thermographic measurements (ITM)



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- evaluated animals n=137

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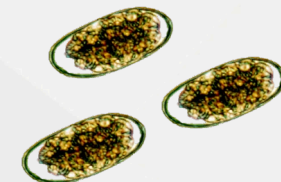
Additional parameters



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- additionally the following parameters were assessed
 - age at time of examination
 - weight at time of examination
 - milk yield [kg] based on performance testing at time of examination
 - cell count (CC) based on performance testing at time of examination
 - faecal egg count (FEC) using McMaster method



Animals & methods

Statistics



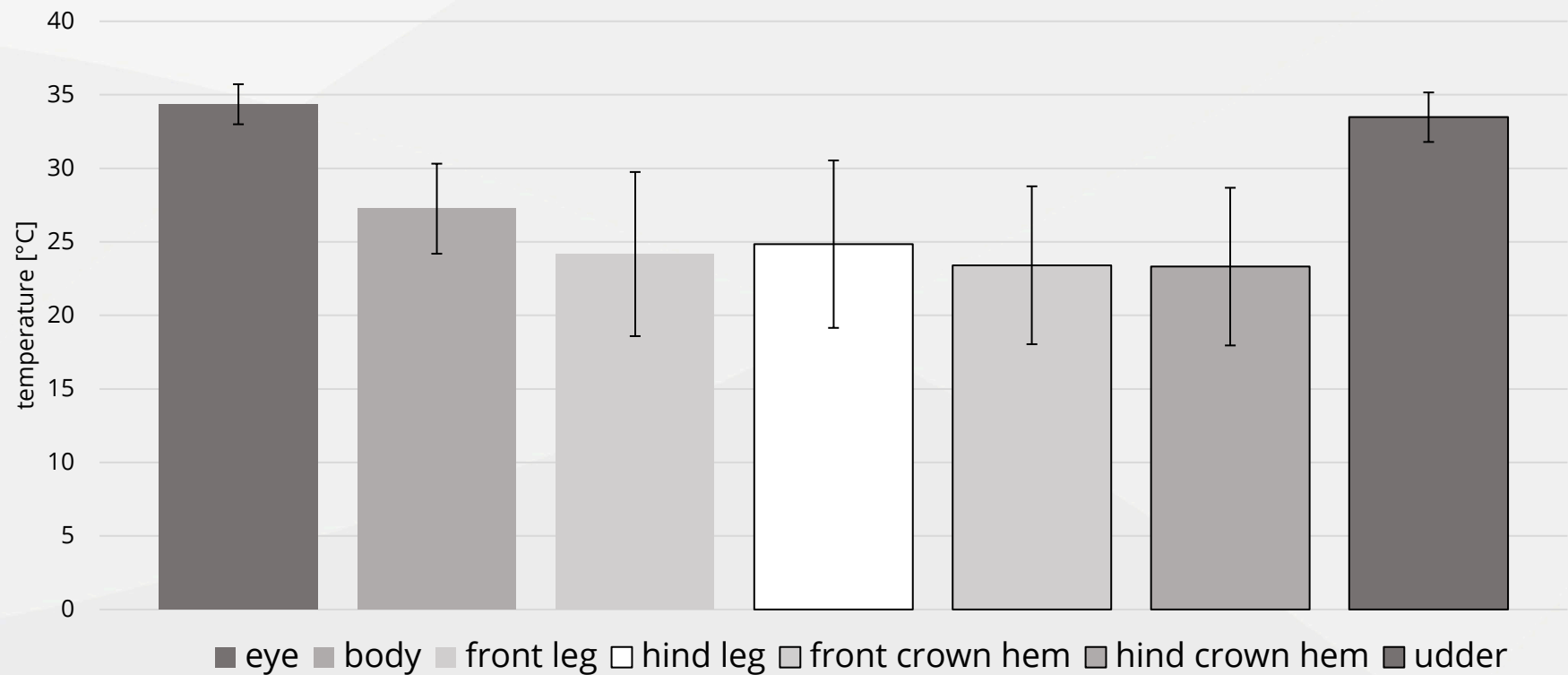
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- SAS[®] Studio
 - mixed model procedure to calculate influencing effects for infrared temperatures
 - correlation model to estimate correlations
 - significance level of $p \leq 0.05$

Results and Discussion

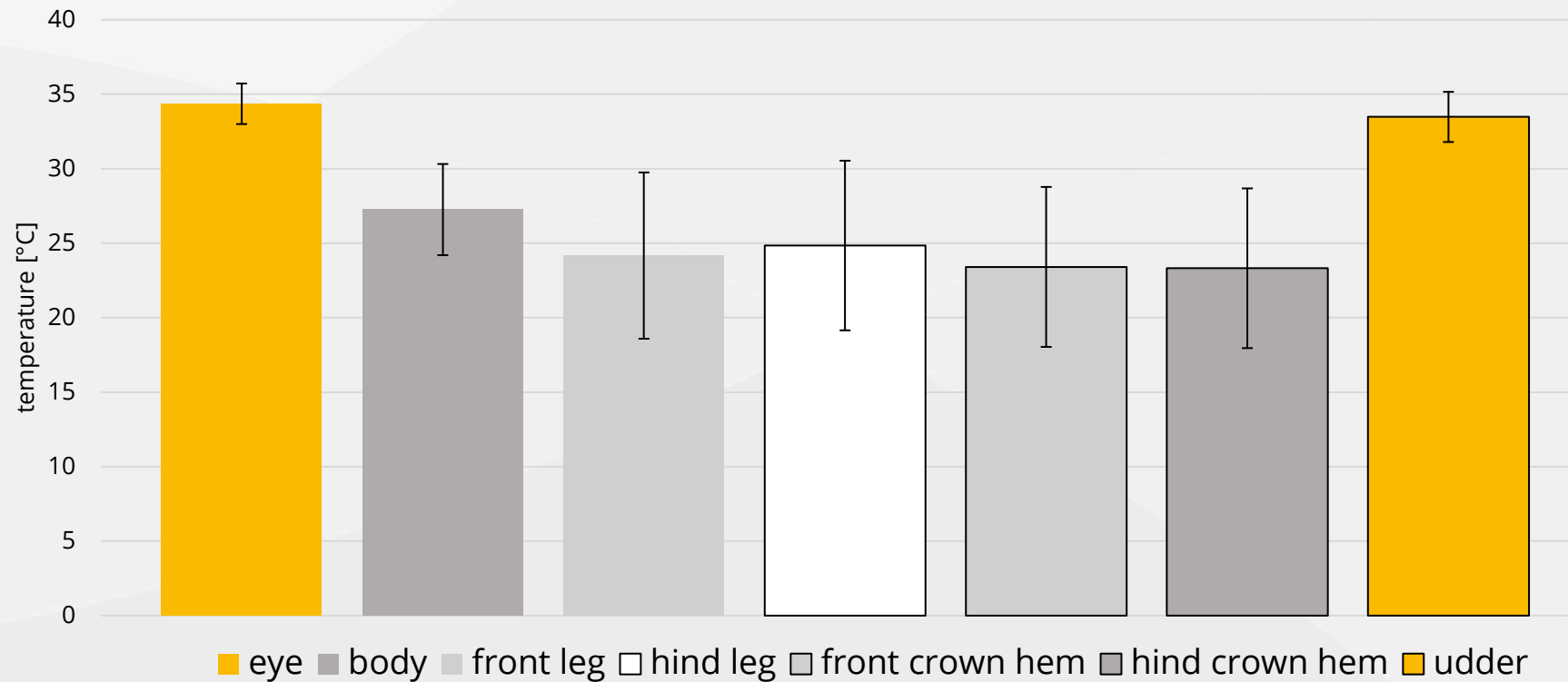
Overview of analysed ITM's



	eye	body	front leg	hind leg	front crown hem	hind crown hem	udder
mean ± SD	34,36 ± 0,45 ^a	27,26 ± 0,39 ^b	24,17 ± 0,39 ^{cde}	24,84 ± 0,39 ^c	23,41 ± 0,40 ^{de}	23,32 ± 0,41 ^e	33,48 ± 0,43 ^a

Results and Discussion

Overview of analysed ITM's



- no significant difference between ITM eye and ITM udder
 - rectal body temperature can be displayed by ITM eye (Georg *et al.*, 2014)
 - ITM eye and ITM udder are highly correlated (**$r=0.63$** , $p<0.0001$, $n=84$)
 - assessment of ITM udder as health parameter in the milking parlour? (McManus *et al.*, 2022)

Results and Discussion

Overview of analysed ITM's



- no significant difference between left and right side for all ITM's
- as well as no significant differences between front and hind leg measurements
 - time saving, evaluation of only one body side for further studies?

Results and Discussion

Influence of age and weight



	age 1 to <3 years	age 3 to <6 years	age >6 years	p-Value
ITM hind leg [°C] n=126	24.91 ± 0.82 ^a	23.69 ± 0.79 ^{ab}	21.61 ± 0.82 ^b	0.0187
ITM udder [°C] n=112	34.21 ± 0.26 ^a	33.26 ± 0.27 ^b	32.91 ± 0.27 ^b	0.0019

- significant differences regarding age categories for ITM hind leg and ITM udder
 - correlation ITM hind leg – age ($r=-0.24$, $p=0.0059$, $n=126$)
 - correlation ITM udder – age ($r=-0.34$, $p=0.0002$, $n=112$)
 - younger animals have higher infrared temperatures
 - maybe this is explainable due to higher metabolism activity

	weight <55 kg	weight ≥55 to ≤ 75 kg	weight >75 kg	p-Value
ITM hind crown hem [°C] n=122	22.28 ± 1.05 ^a	22.65 ± 0.66 ^a	25.39 ± 0.92 ^b	0.0317

- significant differences regarding weight category >75 kg for ITM hind crown hem

Results and Discussion

Udder health and ITM's



	CC <200,000 cells/ml	CC ≥200,000 ≤1,000,000 cells/ml	CC >1,000,000 cells/ml	p-Value
ITM front leg [°C] n=106	28.07 ± 1.18 ^a	24.20 ± 0.71 ^b	23.75 ± 0.89 ^b	0.0094
ITM front crown hem [°C] n=106	28.93 ± 1.18 ^a	25.12 ± 0.71 ^b	24.24 ± 0.87 ^b	0.0057
ITM hind leg [°C] n=102	27.13 ± 1.14 ^a	22.97 ± 0.70 ^b	23.43 ± 0.88 ^b	0.0082
ITM hind crown hem [°C] n=100	26.84 ± 1.16 ^a	23.10 ± 0.71 ^b	22.73 ± 0.91 ^b	0.0126
ITM udder [°C] n=90	34.47 ± 0.40 ^a	33.58 ± 0.24 ^{ab}	33.26 ± 0.31 ^b	0.0653

- milk yield has no influence on infrared temperatures (n<100)
- significant differences regarding cell count (CC) with limbs: higher ITM results in lower CC
- no significant differences regarding CC for ITM udder, but r=-0.28 (p=0.0086, n=90)
- maybe ITM can be used to estimate CC in dairy goats
 - but can CC be used as an udder health indicator? (Persson and Olofsson, 2011)
- maybe adapted CC categories should be used

Results and Discussion

Parasitic health and ITM's



	FEC ≤500 EpG	FEC >500 ≤1,500 EpG	FEC >1,500 EpG	p-Value
ITM front crown hem [°C] n=132	27.85 ± 0.77 ^a	22.67 ± 0.68 ^b	24.42 ± 1.05 ^b	<0.0001
ITM hind crown hem [°C] n=122	25.72 ± 0.75 ^a	21.42 ± 0.69 ^b	22.89 ± 1.05 ^b	0.0002

- significant differences regarding FEC categories for ITM crown hem
 - correlation ITM crown hem – FEC (r=-0.33, p=0.0002, n=121)
- lower FEC's result in higher ITM's
- maybe ITM's can be used to screen for FEC?

Conclusion



- infrared temperatures are interesting for health examination in dairy goats
 - possible to use on farm (milking parlour)
 - possible method to generate new health traits (FEC, CC)
- further research needed
 - larger samples of animals are necessary to validate the previous results
 - influencing physiological mechanisms are not known until now

Special thanks to the German Federal Ministry of Food and Agriculture

for funding our project (funding code 28N-2-035-02)

*Gefördert im
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Gefördert durch:



aufgrund eines Beschlusses
des Deutschen Bundestages

Projektträger



**Förderkennzeichen:
28N-2-035-01**



UNIVERSITÄT
HOHENHEIM



Andreas Kern Projektbeirat





**Thank you for
your attention!**



Sara Alexandra Goth
Research assistant
Nürtingen-Geislingen University
Institute for applied agricultural research (IAAF)
Hechingerstr. 12
D-72622 Nürtingen
Mail: sara.goth@hfwu.de



Results and Discussion



- General health – age and weight
 - Age has no influence on faecal egg count
 - Age has no influence on milk yield, but weight has ($r=0.28348$, $p=0.0035$)
 - Age has an influence on cell count ($r=0.40265$, $p<0.0001$), but weight has no influence
 - Age has an influence on weight ($r=0.39585$, $p<0.0001$)

Results and Discussion

- Udder health
 - Milk yield has no influence on infrared temperatures ($n < 100$)
 - Significant differences regarding CC categories for ITM front leg
 - No correlation ITM front leg – CC ($p = 0.0592$, $n = 106$)
 - Significant differences regarding CC categories for ITM front crown hem
 - No correlation ITM front crown hem – CC ($p = 0.1012$, $n = 106$)
 - Significant differences regarding CC categories for ITM hind leg
 - No correlation ITM hin leg – CC ($p = 0.0516$, $n = 102$)
 - Significant differences regarding CC categories for ITM hin crown hem
 - No correlation ITM hind crown hem – CC ($p = 0.0923$, $n = 100$)

Results and Discussion



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- Udder health
 - No significant differences regarding CC categories for ITM udder
 - correlation ITM udder – CC ($r=-0.27559$, $p=0.0086$, $n=90$)
 - Paper beim Rind Temperatur Euter mit hoher Zellzahl -> Diskussion man sieht nur Effekt

Results and Discussion

- Parasitic health
 - Significant differences regarding FEC categories for ITM body
 - Correlation ITM body – FEC ($r=-0.22369$, $p=0.0125$, $n=124$)
 - Significant differences regarding FEC categories for ITM front leg
 - Correlation ITM front leg – FEC ($r=-0.34282$, $p=0.0001$, $n=122$)
 - Significant differences regarding FEC categories for ITM front crown hem
 - Correlation ITM front crown hem – FEC ($r=-0.32927$, $p=0.0002$, $n=121$)
 - Significant differences regarding FEC categories for ITM hin leg
 - Correlation ITM hind leg – FEC ($r=-0.37920$, $p<0.0001$, $n=115$)
 - Significant differences regarding FEC categories for hind crown hem
 - Correlation ITM hind crown hem – FEC ($r=-0.33450$, $p=0.0003$, $n=111$)

Animals & methods - statistics

- Faecal egg count (FEC) was scored in three categories:
 - Low FEC categorie (≤ 500 Eggs per Gram faeces)
 - Medium FEC categorie ($> 500 \leq 1500$ Eggs per Gram faeces)
 - High FEC categorie (> 1500 Eggs per Gram faeces)
- Age was scored in three categories: 1 to < 3 years; 3 to < 6 years; > 6 years
- Weight was scored in three categories: < 55 kg; ≥ 55 to ≤ 75 kg; > 75 kg
- Milk yield was scored in three categories: best 25% of the herd; the worst 25% of the herd; the middle of the herd
- Cell count was scored in three categories: < 200.000 cells/ml; 200.000 to 1.000.000 cells/ml; $> 1.000.000$ cells/ml