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Use of a respiration rate sensor in dairy cows as an animal-based welfare indicator

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Background

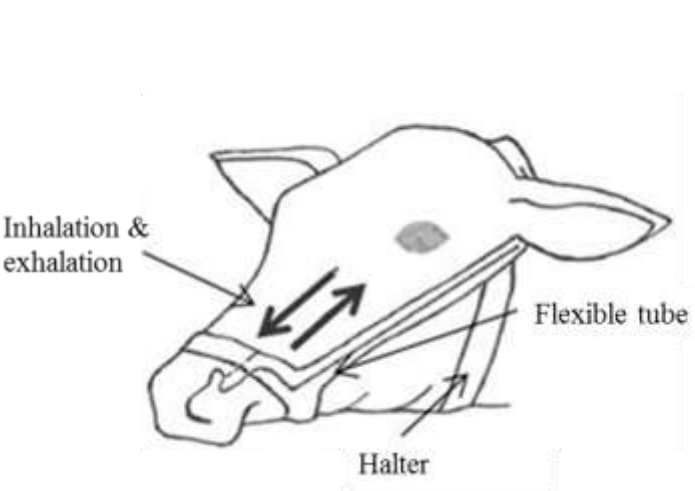
- Measurement of respiration rate (RR) in cattle is an important and essential indicator to monitor health and well-being
- A common method to record the RR is counting the flank movement visually
- Visual counting is time-consuming, labor-intensive and not constantly possible
- Presence of an observer can cause stress and hence affect the RR of the animal, which can falsify the measurements
- Increased RRs can serve as an individual stress indicator, especially under heat stress situations

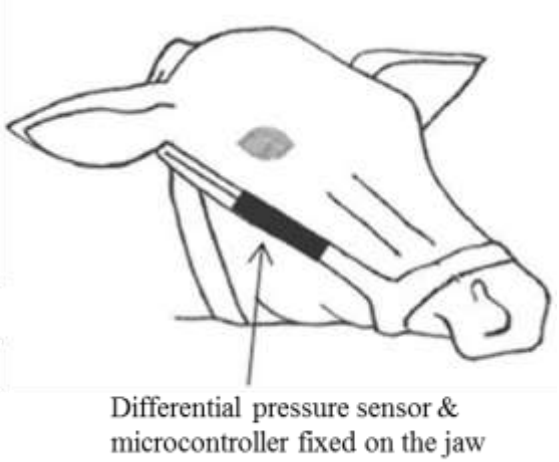
Aim of the study

- Develop a sensor device to measure respiration rate in cows continuously and automatically
- Sensor requirements
  - Non-invasive
  - No influence on the natural behaviour of the cow
  - Without losses
  - long-term durability (robustness, battery life, data storage capacity)
  - Reliable (high sensitivity and specifity)

A novel sensor for respiration rate recording

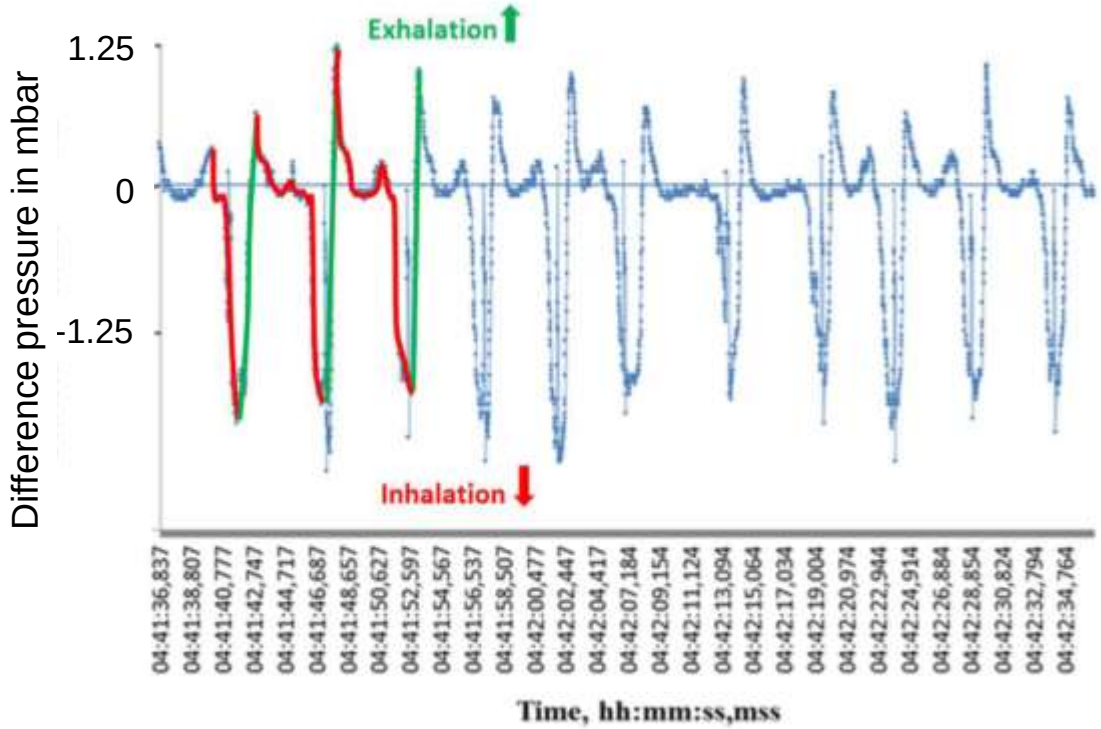
- Based on a differential pressure sensor, a microcontroller, a power bank and software to analyse the data
- The sensor was positioned to a halter on the right side of the head
- A flexible silicone tube connected the pressure sensor with the left nostril and ended in the nasal cavity





Respiration curve

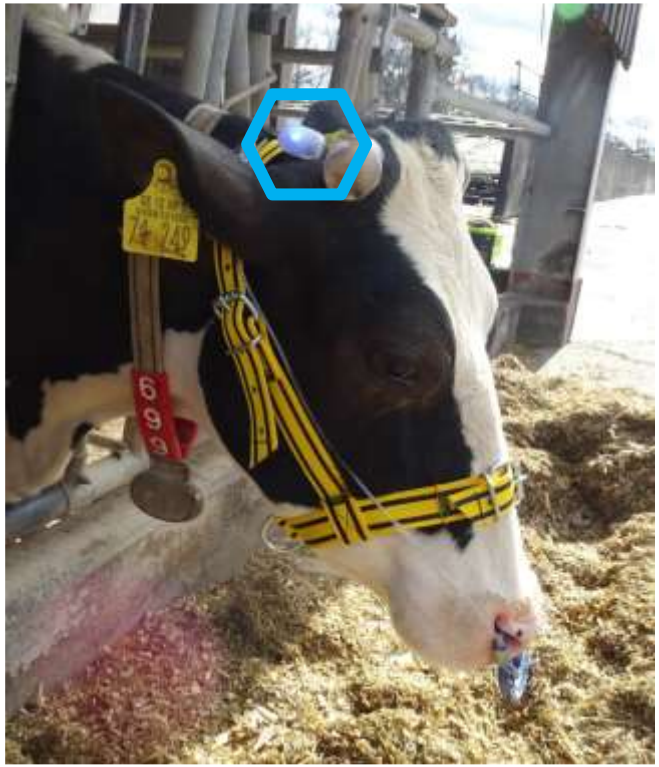
Differential pressure of the RR, measured by the sensor



Material and methods of the pilot study

- 6 lactating Holstein Friesian dairy cows (1st to 5th lactation)
- Naturally ventilated barn in Groß Kreutz (Brandenburg, Germany)
- Daily milk yield: 40.7 ± 6.8 kg
- Herd size: 54 cows
- Data collection took place on two days and one night
  - five cows 8 a.m. to 6 p.m. the same day
  - one cow 8 a.m. to 8 a.m. the following day
- Videos were made regularly for visual counting of RR afterwards
- Cow body posture (standing vs. lying) was documented

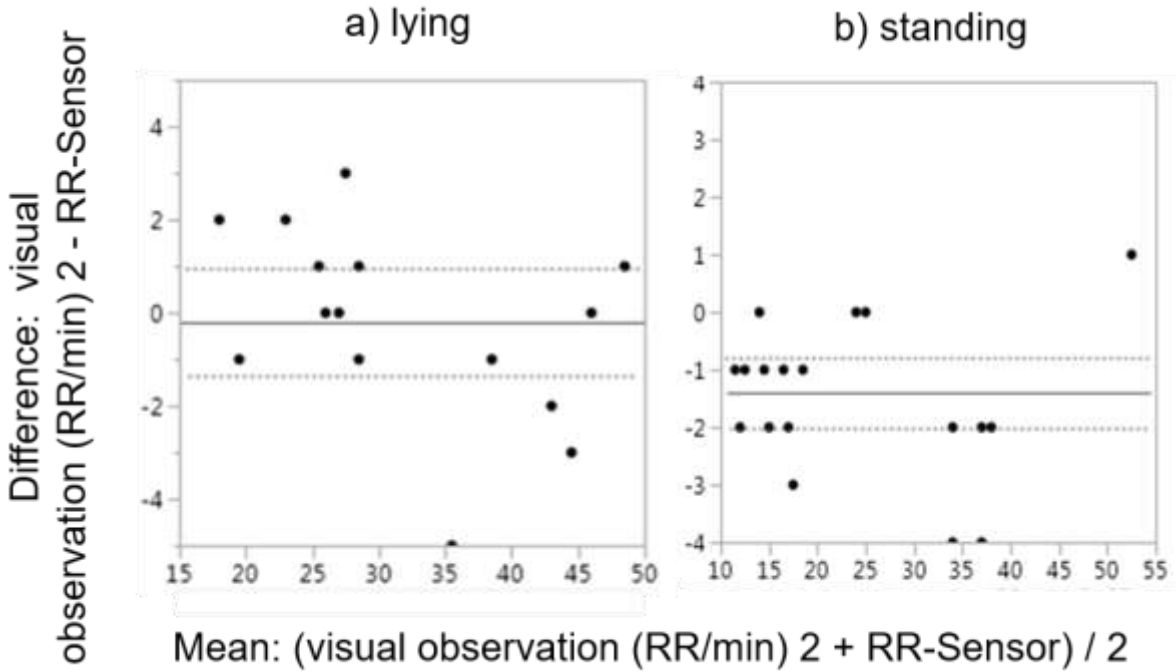
Light-emitting diode (LED) connected to the sensor



- LED lights to control the function of the sensor and SD card (green and red light)
- Blue flashing LED signal at the beginning of every minute as marker and for synchronization of the visual counting afterwards

Results

- Bland-Altman Plot



- Positive correlation (Bravais-Pearson) between automatic and visually counted respiration rate in lying (r=0.98) and standing cows (r=0.99)
- Cows accepted the sensor
- No obvious outward impairment in behaviour and health

Ongoing developments

- Sensor can now be attached without halter
- Remote data access is possible
- Software automatically calculates the current breathing rate of the cow

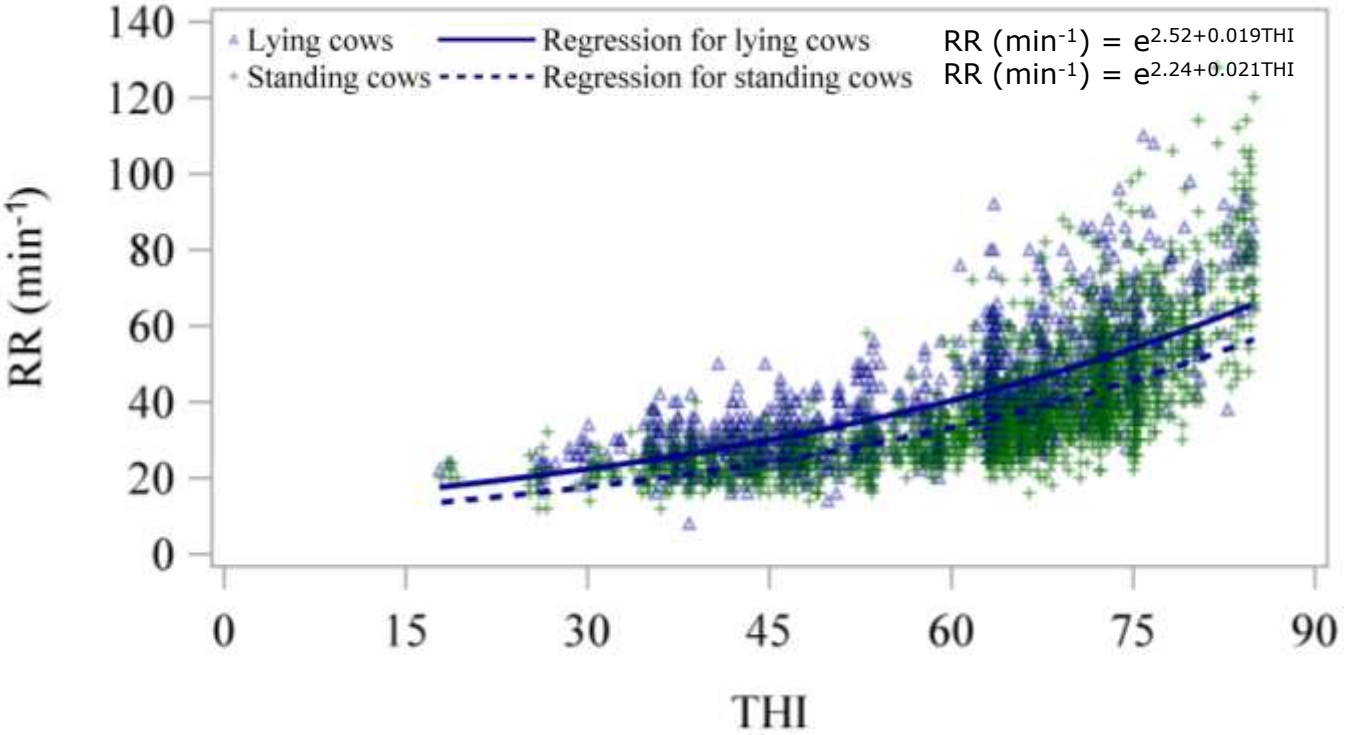
www.gouna.tech

Respiration rate as indicator for heat stress

- Increase in respiration rate as option to reduce heat load (evaporative thermoregulation)
- With increasing ambient temperature and temperature humidity-index (THI≥68) the respiration rate increased from 35±0.99 to 75±1.39 bpm (MW±SE)

Source: ATB

Correlation between heat stress and respiration rate (RR)



- Respiration rate of lying cows was higher than that of standing cows

Pinto et al. (2019),
Ann. Anim. Sci. 19, 469–481

Conclusions

- A continuous measurement of RR is possible without disturbing the cows. The behaviour of the animals was not influenced during the trial.
- Measuring the RR continuously can help to react early to an increasing RR (for example due to heat stress or diseases) and to promote the welfare of the animals individually or on a herd basis.
- Further tests and developments with the software and the sensor device are already in progress.

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