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中荷奶业发展中心

SINO-DUTCH DAIRY DEVELOPMENT CENTRE

Heat management strategies on dairy farms

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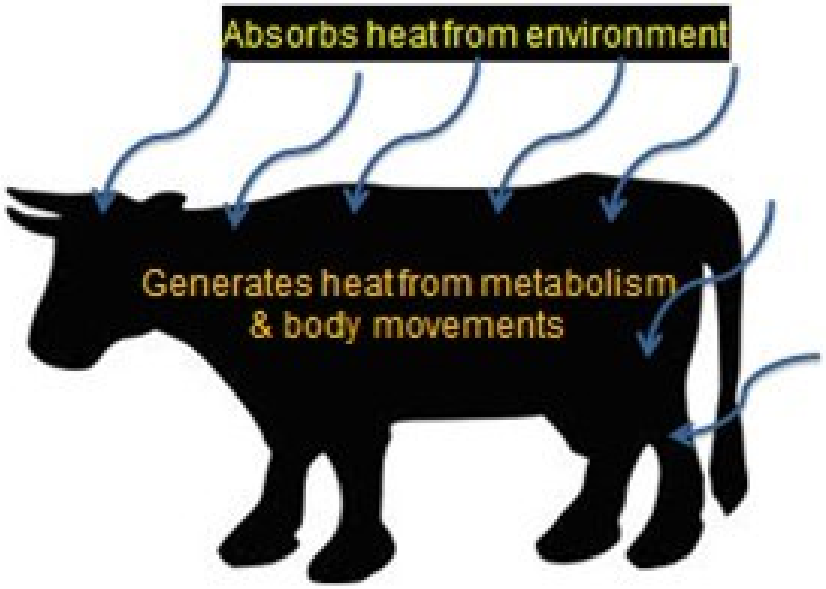
Heat stress in dairy cows

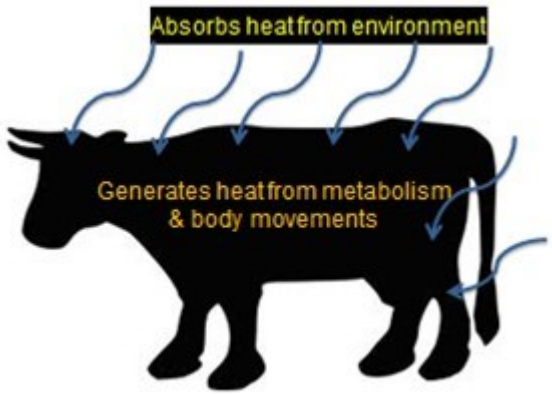
- Thermo-regulation
- Constant body temperature - homeostasis



Heat stress in dairy cows

- Heat stress
- Ambient tempratures above the **thermoneutral zone**
- Thermoneutral zone TNZ:
  - Defined as the range of ambient temperatures without regulatory changes in metabolic heat production or evaporative heat loss

    - Temperature
    - Air speed
    - Solar radiation
    - Relative humidity



Heat stress

- High Temperature – Humidity – Index **THI**
- Often used THI formula: (Kelly & Bond, 1971)
  - $THI=(1.8\times T+32)-(0.55-0.0055\times RH\%)\times(1.8\times T-26)$
    - T= ambient temperature
    - RH= relative humidity
  - Empirical formula
    - Regional differences
    - Arid regions with low RH
    - Humid areas with high RH

Heat stress

- THI threshold values:
  - Different for breeds and strains
    - Holstein cows >68; Jersey >73 (Bryant et al., 2007)
  - Different threshold for climatic conditions (Bohmanova 2007)
    - Different THI formula's differ in their ability to detect heat stress
    - THI's with large weights on RH%: more suitable for humid climates
    - THI's with large weights on T: more suitable for arid climates
  - Different for milk production level
    - 45 kg milk vs. 35 kg threshold value 5 points lower
      - Metabolic activity

Heat stress

- THI threshold values:
  - THH < 68 No stress
  - THI 68 - 75 Mild heat stress
  - THI 76 – 85 Heat stress
  - THI 85 – 95 Severe heat stress
  - THI > 95 Lethal heat stress

Heat stress in dairy cows

- How cows cope with heat stress:
  - Reduce heat absorption from environment
    - Seek shade, move away from the sun
    - Crowd together
    - Refusal to lie down (easier breathing)
  - Increase evaporative heat loss
    - Increase breathing rate
    - Increase sweating
    - Higher water intake
  - Reduce metabolic heat production
    - Decrease feed intake
    - Decrease milk production, fat % and protein % content
    - Reduce activity

Heat stress in dairy cows

- Impact of heat stress on dairy cows:
  - Hormonal changes
    - Reduced plasma levels
      - Growth hormone
      - Thyroxine
      - Glucocorticoids
      - Aldosterone,
      - Oestradiol
    - Increased prolactin

Heat stress in dairy cows

- Impact of heat stress on dairy cows:
  - Negative impact on reproductive performance
    - Reproduction behavior (cows show no heat)
    - Effect on duration of estrus
    - Reduced conception rate
    - Follicular develop
    - Early embryonal development
  - Reduced colostrum quality
  - Higher Somatic Cell Count, mastitis

  - **Negative impact on longevity!**

Heat stress in dairy cows

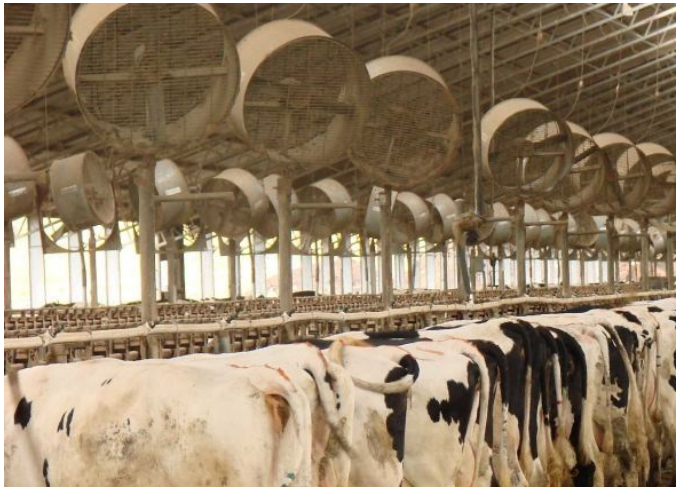
- Impact of heat stress on dairy cows:
  - Reduce metabolic heat production
    - Reduce heat production from ruminal fermentation
  - Reduced activity
  - Reduced feed intake

Heat stress in dairy cows

- Reduced feed intake
  - Cascade of effects:
    - Reduced nutrient intake
    - Less energy nutrients for milk production
    - More severe negative energy balance NEB
      - NEB associated with
      - Fatty liver (increased fat mobilization)
      - Reduced reproduction
    - Reduced roughage intake
      - Reduced rumination
        - Reduced saliva production – reduced buffer capacity
        - Low rumen pH
      - VFA production acetate/propionate ratio's
        - Reduced milk fat production

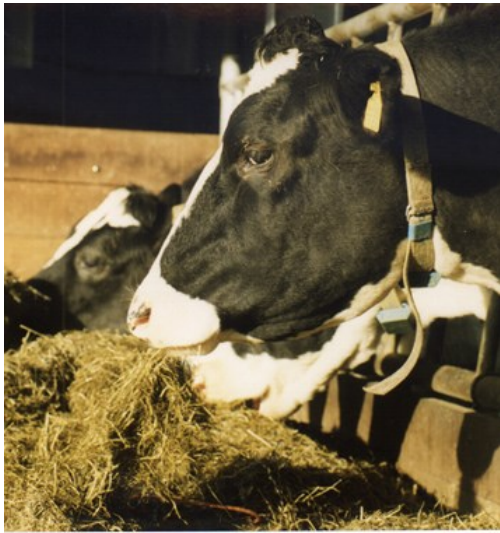
Heat stress management

- The obvious things to mitigate heat stress
  - Cooling: reduce ambient temperature
    - Increase air speed - Fan
    - Water sprinklers
      - Increase humity – Only combined with fans
  - Provide shade
    - Well ventilated roof insulated barns
  - Apply this measures to all cows:
    - Do not forget dry-cows!



Heat stress management

- Feeding management with heat stress
  - Minimize the impact on feed and nutrient intake
  - Increase energy density of the diet
  - Improve feed intake



Heat stress management

- Increase energy density of the diet
  - High quality forage
    - Remove low quality and fibrous forages from the TMR
      - Poor hay, alfalfa, maize stover
      - Good quality alfalfa, corn silage
  - Increase concentrate proportion
    - Be aware of sufficient effective fiber
      - Avoid excess of higher raid fermentable carbo hydrates
    - Provide cows with sodium bicarbonate buffer
      - Buffer rumen pH

Heat stress management

Prevention of Rumen Acidosis

Minimum	Minimum	Maximum
forage NDF	NDF in TMR	NFC in TMR
19%	25%	44%
18%	27%	42%
17%	29%	40%
16%	31%	38%
15%	33%	36%

NFC Non fiber carbohydrates = Starch+Sugar+Pectins NRC 2001

Heat stress management

- Increase feed intake
  - Provide palatable feeds
    - No moulded or heated silage
    - Prevent heating of silage
      - High ambient temperatures increased risk of silage heating
      - Finely chopped, good compaction at harvest
      - Good silage face management, sharp cut, clean
      - Design of the bunker
        - Bunker dimensions
        - Feed out rate > 0.3 m/day
        - Silage face at the north side
      - Heat prevention
        - Use heat reducing additives
        - **Heterofermentative LAB**
        - Sodium/potassium sorbate

Heat stress management

- Increase feed intake
  - Increase feeding frequency
    - Provide smaller meals
      - More feedings less selection against fibrous parts
      - Less heating of feed at the feed bunk
      - Competition between cows
      - Fresher feed, less deterioration due to heating and spoilage
  - Check Dry matter of the TMR
    - 35-45% DM, add water
    - Less selection (concentrate ‘sticks’ to forage)

Take home message

- Heat stress management:
  - is more than “cooling the cows”

- Feeding management with heat stress
  - Cows reduce feed intake
    - Cascade of effects

- **Promote feed and nutrient intake!**

Take home message

- **Promote feed and nutrient intake!**
  - Increase energy density of the TMR
    - Avoid low quality and fibrous forages
    - Increase concentrate proportion, but
      - be aware of rumen acidosis
        - Buffers, suffient fiber
  - Provide palatable feeds
    - Prevent heating of silage
      - Prevention of silage heating starts at harvest
    - Increase feeding frequency -> Fresh TMRs
    - Don’t forget the dry cows

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Expert meeting 31 May 2016

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