HEAT STRESS AND CATTLE

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- ✓ Experience with dairy and beef production in 28 countries, including India
- ✓ Raises beef, poultry and pork on own farm

HEAT STRESS AND CATTLE

- World-wide implications of heat stress with animal agriculture
- Cattle responses to heat stress
- Managing for heat stress
- Questions and answers

WHAT IS HEAT STRESS?

TEMPERATURE-HUMIDITY INDEX – DAIRY CATTLE

C	20	30	40	50	60	70	80	90	100
22	66	66	67	68	69	69	70	71	72
24	68	69	70	70	71	72	73	74	75
26	70	71	72	73	74	75	77	78	79
28	72	73	74	76	77	78	80	81	82
30	74	75	77	78	80	81	83	84	86
32	76	77	79	81	83	84	86	88	90
34	78	80	82	84	85	87	89	91	93
36	80	82	84	86	88	90	93	95	97
38	82	84	86	89	91	93	96	98	100
40	84	86	89	91	94	96	99	101	104

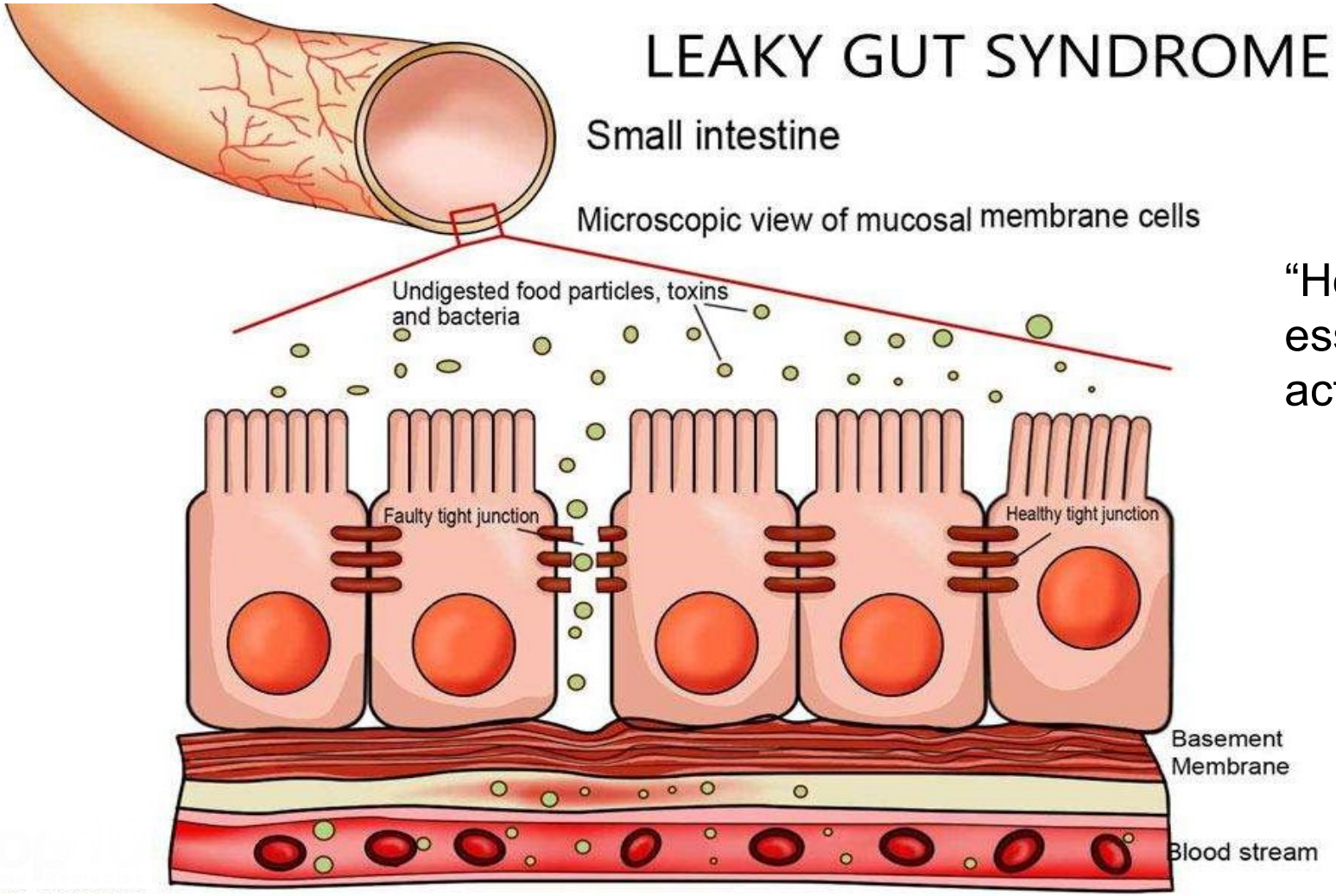
No Stress
Mild Stress
Moderate Stress
Severe Stress
Dead Cows

HEAT STRESS: ECONOMICS AND FOOD SECURITY

- Cost:
  - ✓Lost milk production or weight gain
  - ✓Reduced reproduction
  - ✓Impaired immune function
  - ✓Reduced milk quality
  - ✓Global animal agriculture: >28 trillion rupee

CATTLE RESPONSES TO HEAT STRESS

- Increased respiration removes heat, and CO_2 and water
- Reduced dry matter intake….reduced nutrient intake
- Diversion of blood flow to skin and extremities
  - Attempt to maximize radiant heat dissipation
- Coordinated vasoconstriction in intestinal tissues
  - Reduced nutrient and oxygen delivery to enterocytes
  - Reduced oxygen increases reactive oxygen species
- Reduced water balance increases rumen and intestinal osmolarity
- Reduced water balance causes cell shrinkage and death

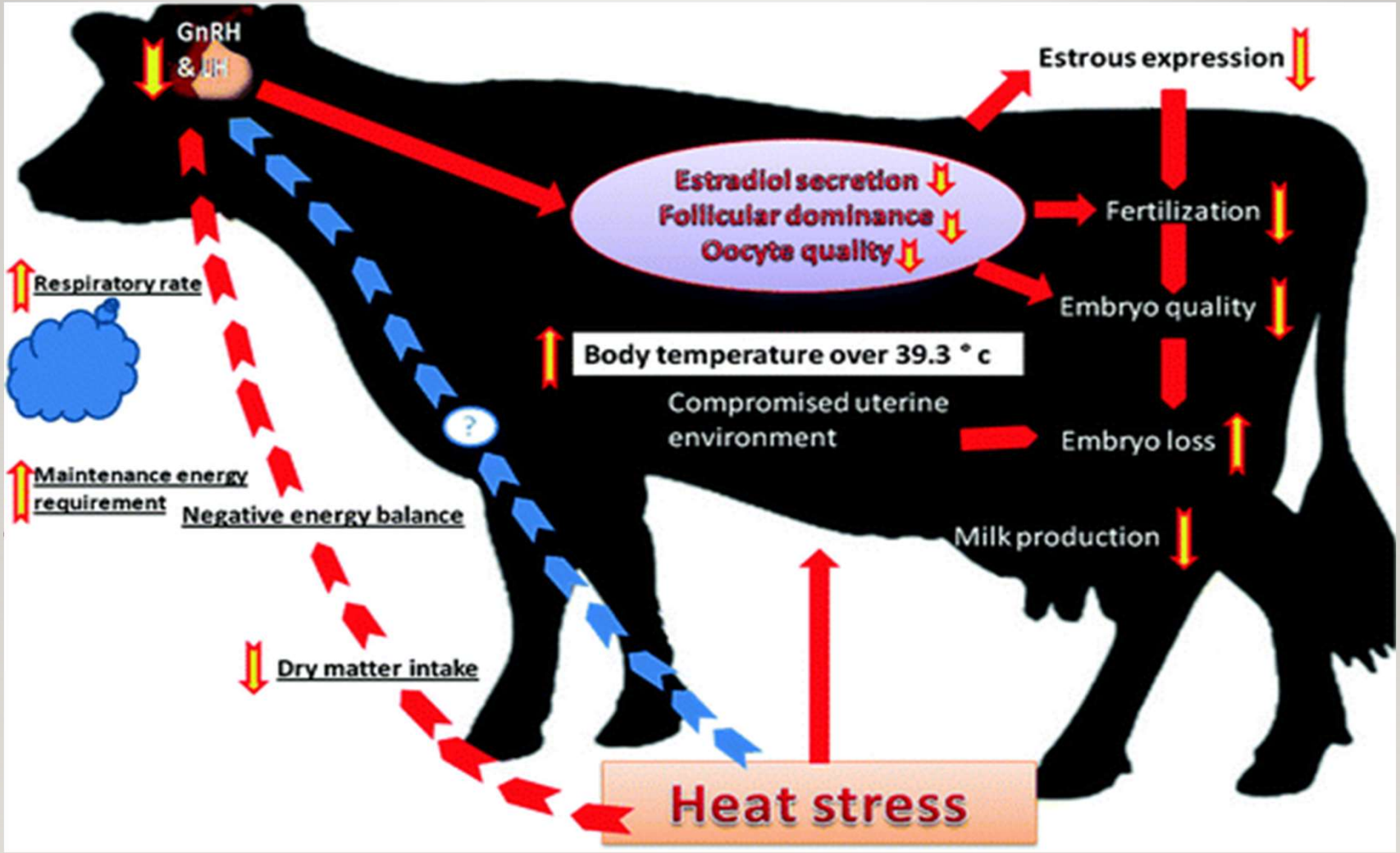


"Heat stress is essentially immune activation"

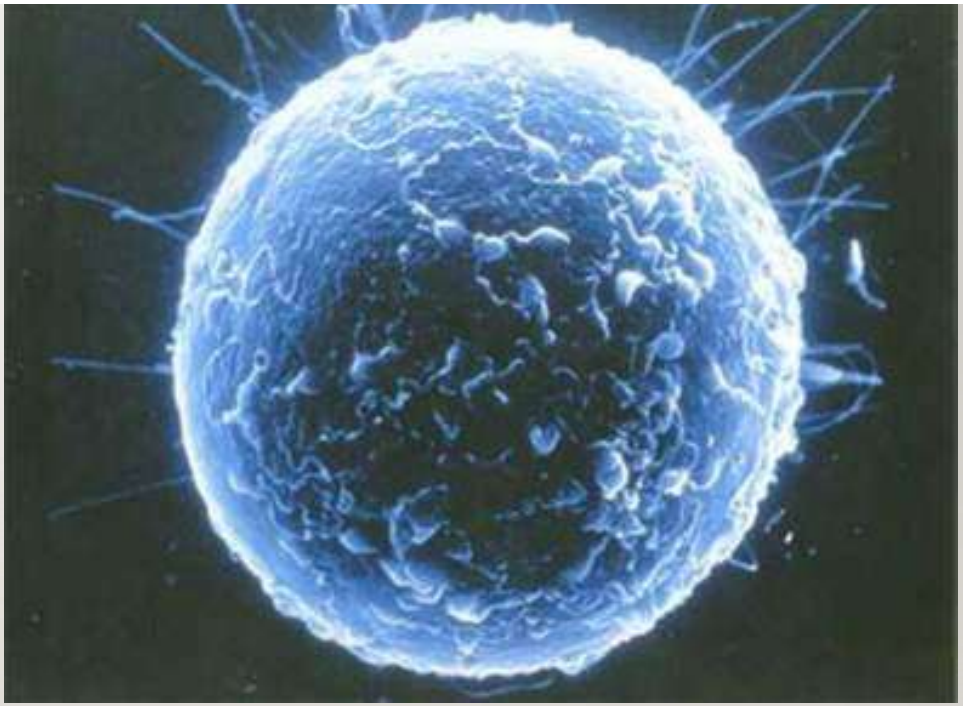
Lance Baumgard, Ph.D.
Iowa State University

HEAT STRESS IS A GLUCOSE DRAIN

- Heat stress increases glucose demand ~450g/d
- Glucose is made in the liver primarily from propionate and lactate
- Glucose makes lactose (milk sugar) and milk fat
- 72 g glucose per 1 kg milk
- Milk yield is primarily determined by the amount of synthesized lactose


GnRH
& LH
Estrous expression
Estradiol secretion
Follicular dominance
Oocyte quality
Fertilization
Embryo quality
Respiratory rate
Body temperature over 39.3 ° c
Compromised uterine environment
Embryo loss
Maintenance energy requirement
Negative energy balance
Milk production
Dry matter intake
Heat stress

HEAT STRESS CAUSES EARLY EMBRYONIC DEATH



A body temperature increase by 0.5°C causes a decline in conception rate by 12.8%

(Gwazdauskas et al, Journal of Dairy Science 56:873)

HANDLING HEAT STRESS

The best way to handle heat stress is to physically modify the environment to reduce heat stress.

- ✓**We must become agricultural engineers**
- ✓**Shade**
- ✓**Evaporative Cooling**
- ✓**Air movement**

PHYSICALLY MODIFY ENVIRONMENT TO REDUCE HEAT STRESS

Bare Ground Surface Temperature Before and After Shading At Various Times During The Day				
Shade Time (minutes)	Temperature of Ground Surface (°C)			
	11 am	12 Noon	2 pm	4 pm
Air temperature	33.3	35	36.7	40
In sun	51.6	62.4	66.6	67.2
5	40	42	44.2	45.4
15	36.7	39.5	43.0	43
30	36.7	38.5	40	41

Kelly et al., 1950

Smidley

PHYSICALLY MODIFY ENVIRONMENT TO REDUCE HEAT STRESS

- Evaporative cooling
- Heat is required to convert water into vapor
  - 540 calories/g water at 40C
- Evaporate water off the skin

COOLING PONDS OR

COOLING RIVER

Mastitis?

PHYSICALLY MODIFY ENVIRONMENT TO REDUCE HEAT STRESS

- Air movement
- Natural ventilation
- Fans

WATER: QUANTITY, QUALITY, AVAILABILITY

Animal	21°C	32°C
	Liters/d	
Dry cow	33	38
Cow, 20 kg/d	80	100
Cow, 36 kg/d	125	170
Calf, 1 month-old	15	20

HEAT ABATEMENT

- Reduce walking distance
- Reduce standing time or holding pen time
- Maximize cow comfort

WHERE TO COOL COWS?

- Tie-stalls, free stalls or dry lots
- Pre-fresh pens – Heat stress affects the unborn calf…and its calves!
- Maternity pen
- Feed bunks
- Pastures
- Don’t lock up during mid-day
- ….Everywhere!

DIETARY STRATEGIES TO REDUCE HEAT STRESS

- Digestible fiber: save best forages for hot months
- Electrolytes: Na, K, Mg
- Starch: maize and rice makes propionate makes glucose
- Betaine: osmolyte to keep moisture, from sugar cane
- Antioxidants – vitamins A and E
- Trace minerals: chelate Zn, Mn, Cu, Co
- Vasodilators: capsacin from chili peppers

HEAT STRESS DRENCHES

- Clean water
- Electrolytes: Na, K, Mg
- Propylene glycol
- Glycerol
- Antioxidants – vitamins A and E
- Trace minerals: chelate Zn, Mn, Cu, Co

HEAT STRESS SEMINAR SUMMARY

- Heat stress reduces every production measurement
- Heat stress costs everyone associated with animal agriculture
- Reduced feed intake is only part of the problem
- Heat-induced leaky gut
- Heat stress is essentially an immune activator
- Heat stress abatement (shade, evaporative cooling, ventilation) is biggest priority
- Energy-dense, low-fiber diet to enhance immune activity