Continuous summer hutch ventilation for dairy calves

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The *zone of thermoneutrality* is the temperature range between which no additional energy is needed to maintain body temperature. For young dairy calves, that *zone of thermal neutrality* ranges from 15 to 26º C (59 to 79º F) for calves less than 3 weeks of age while for calve past that age the lower critical temperature drops further to 5º C (41º F) according to the 2021 Dairy NASEM. Recently, studies have been done at the Universities of Florida, Georgia, and Wisconsin to assess impact of heat stress and amelioration on calves. During hot weather, that heat of rumen fermentation becomes a negative factor and causes calves, and cows too, to reduce it by eating less (Kertz 2019).

NAHMS 2014 found that about 70% of preweaned calves were individually housed. Probably at least one-half of those are housed in hutches. Larsen et al., (2026) designed to "evaluate the effects of early-life continuous active ventilation on heifer growth, health, thermoregulation, hutch use, and standing and lying behaviors, as well as to characterize the air quality within actively ventilated hutches compared with passively ventilated hutches during a continental summer, characterized by hot daytime temperatures, large diurnal temperature variation and elevated humidity."

"This study was conducted from June 12, 2022, to September 27, 2022, at the UW–Madison Arlington Agricultural Research Station (Arlington, WI). This study was a randomized controlled trial with blocking.

- A total of 32 Holstein dairy heifers were enrolled sequentially by birth date in 2 consecutive blocks (n = 16 heifers per block). Heifers were housed individually in polyethylene hutches (2.1 × 1.2 × 1.4 m; L × W × H) with a rear window panel (0.64 × 0.39 m) and 2 circular lower window vents (0.31 m in diameter).
- Hutches were bedded with sand, with the hutch opening facing southwest. All calves had free access to an attached wire pen (1.7 × 1.4 × 1.2 m) without supplemental shade. The hutch layout was a row of 16 hutches designed so that 1 fan could provide ventilation to 2 adjacent hutches through a bifurcated tube, so every other pair of hutches was equipped with active ventilation, while the alternating pairs served as passively ventilated controls.
- Treatments were as follows: 1) passive (natural) ventilation (PASS; rear window opened ~20 degrees, plus 2 circular rear lower vents open at 50%), and 2) active ventilation (ACT; solar-powered fan fitted inside a tube attached to the rear-hutch window, plus rear vents open at 50%)…… Fans were controlled via a thermostat and set to turn off at temperatures below 13°C (55°F)…..
- Heifers in block 1 (n = 16; PASS = 8, ACT = 8) were enrolled at birth (day 0). Ventilation treatments began on day 3 and continued until fans were turned off on day 28. Afterward, heifers were moved to neighboring hutches until day 56 to allow for block 2 enrollment within the summer. Hutches were thoroughly disinfected before new heifers

were placed. The remaining heifers (n = 16; block 2) were enrolled sequentially and remained in their hutches until day 56, with fans also turned off at day 28.

- All heifers were fed 3.8 L colostrum (23.7% ± 3.7% average BRIX) within 6 hours of birth either by bottle or tube feeding. Afterward, heifers were fed 2.8 L of whole milk twice daily until day 14, when they increased to 3.8 L of milk twice daily until day 42, when step-down weaning began.
- Heifers were off milk at day 49 and consumed grain exclusively until day 56. Calf starter grain (**Table 1**) was offered once daily starting at day 3, with amounts increased on an as-needed basis throughout the preweaning phase. Daily grain refusals were recorded and converted to a daily DMI and averaged for week 1 to 4. Water was offered ad libitum from birth."

Table 1. Nutrient composition of starter fed free choice.

Item	Starter	SEM
Dry matter (DM), %	90.5	0.28
Nutrients DM basis, %		
CP	21	3.4
Fat	3.99	0.13
ADF	11.25	1.48
aNDF	17.8	1.56
NFC	52	2.83
Ash	6.06	0.86
ME, Mcal/lb	1.36	0.0005
Ca	1.16	0.19
P	0.55	0.04
Mg	0.25	0.01

- Crude protein (CP) was at a reasonable level of about 19% as -fed.
- Non fiber carbohydrates (NFC) of 52% would be mostly starch. If in a well-texturized form, that is not an issue; but if in an all-pelleted form, that is too much for feeding without 5% chapped straw or grass hay also being fed.

Table 2. External (outdoor) daytime and nighttime temperature-humidity index (THI), temperature, relative humidity, wind speed, and solar radiation (average, SD, maximum, and minimum) during the ventilation treatment period (June–August, 2022).

Item	Average	SD	Maximum	Minimum
Daytime, 0600 to 2000 hour				
THI	74.2	8.3	92.3	53.8
Temperature °F	75.0	12.4	94.8	49.4
Relative humidity, %	72.0	16.6	100	31.0
Wind speed, m/second	1.66	1.20	9.06	0.00
Solar radiance, W/m^2	389.9	332.2	1277.0	0.6
Nighttime, 2100 to 0500 hour				
THI	65.8	5.6	84.8	53.0
Temperature °F	65.5	4.8	86.0	51.3
Relative humidity, %	87.0	10.4	100	50.1

Wind speed, m/second	1.18	3.80	7.05	0.00
Solar radiance, W/m^2	1.18	3.80	64.4	0.6

- During **daytime**, THI exceeded the 59 threshold except for the minimum of 53.8.
- Temperature and relative humidity followed a similar pattern as THI with the broadest range for humidity..
- Wind speed was quite low while solar radiance was quite high.
- During **nighttime**, THI was below the lowest threshold of 68 but the 84.8 maximum at night exceeded that threshold.
- Relative humidity was greater at nighttime than during daytime, similar for wind speed, but with essentially no solar radiance.

Authors noted that:

- At the center of the hutches, air from the solar-powered fan was 1.03 m/s higher compared with the air speed in the control hutches recorded at the same location and time (1.1 vs. 0.07 ± 0.02 m/s).
- Daytime internal hutch THI tended to be 0.7 units lower in solar powered fan hutches than in control hutches (77.6 vs. 78.2, respectively).
- Temperature taken at the same time was not different between hutch treatments. However, the difference between hutch and external THI tended to be 0.9 THI units lesser in solar powered fan versus control hutches (5.4 vs. 6.3, respectively).

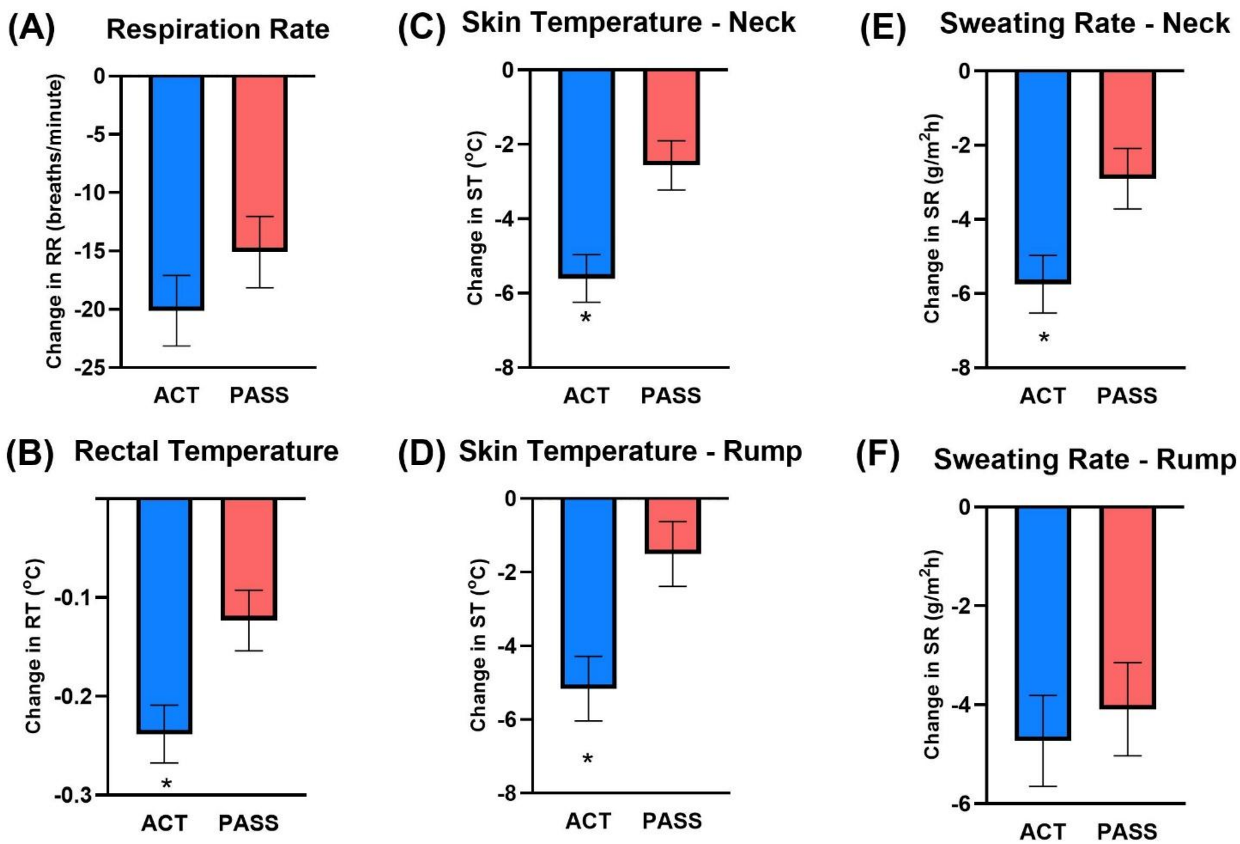

Figure 1 (kindly provide by Dr, Jimena LaPorta**).** Physiological measurements for predicted thermal indices of preweaning heifers raised in outdoor hutches equipped with solar-powered fans attached to the back of the hutch (ACT, blue bars) or not (PASS, red bars) during a continental summer. Data were analyzed as the change in thermal indices (respiration rate, RR; rectal temperature, RT; skin temperature, ST; and sweating rate, SR) after 1-hour external (outside) restriction and one 1-hour internal hutch restriction.

- Calves had greater differences when going from outside to insider hutches for solar powered fan hutch than for the control hutch rate for respiration rate, rectal temperature, skin temperature on neck and rump, and for sweating on neck and rump.
- My interpretation on this is that the solar powered fan hutch calves experienced greater response to the change from outside to inside the hutch than control hutch calves.

Table 3. Body weight (BW) and average daily gain (ADG) of calves in Control or solar powered fan hutches (Fan).

Item	**Fan**	**Control**	**SEM**
During ventilation period, 3-28 days			
Body weight, lb	107.0	108.2	1.3

Daily gain, lb	1.52	1.56	0.04
Starter intake, lb/day	3.88	5.15	0.64
After ventilation period			
42 days			
Body weight, lb	144.5	153.5	2.25
56 days			
Body weight, lb	158.6	180.1	3.59

- Body weight did not differ between treatments at day 28 nor did starter intake differ.
- But body weights were greater at days 42 and 56 for the solar powered fan hutch treatment calves versus the control.
- With height, hip height and chest girth were measured but were not diferent by treatments

A survival analysis was done by treatments (**Figure** 2) with major survival benefit for the solar powered fan hutch calves after the first service for breeding.

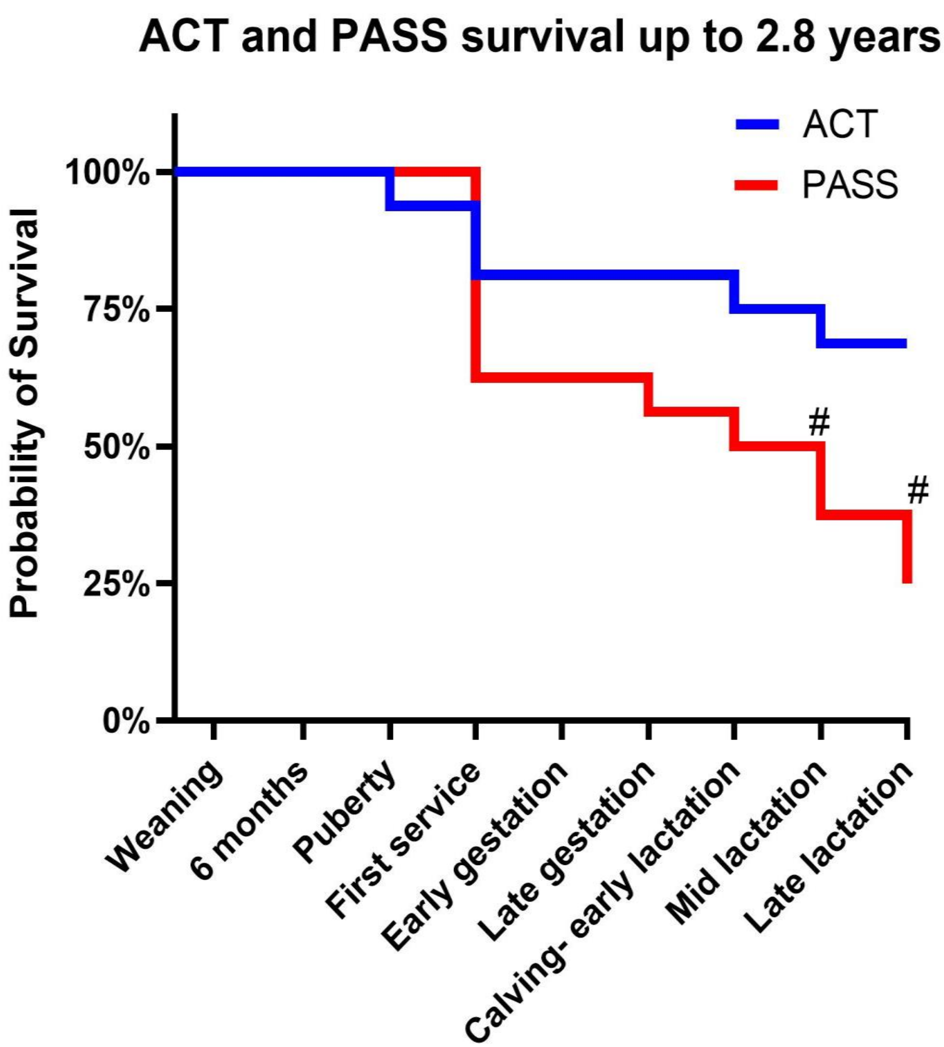

Figure 2 (kindly provide by Dr, Jimena LaPorta)**.** Probability of survival (%) for dairy heifers raised in outdoor hutches with either active (ACT; continuous airflow via solar-powered fans, blue line; n = 16) or passive (PASS; natural ventilation only, red line; n = 16) ventilation during the first 28 days of life in a continental summer. Survival data were obtained from farm life event records and tracked through the completion of first lactation. Endpoints included weaning (56 days), 6 mo (182 days), puberty (304 days), first service (425 days), calving/beginning of first lactation (790 days), mid lactation (912 days), and late (complete) lactation (1,034 days). Significance determined at $P < 0.05$; tendency at $0.05 > P < 0.1$ (marked with #).

While differences in body weight appeared small, calves exhibited greater benefits after their first breeding and thereafter.

The Bottom Line

Providing addition hutch ventilation for calves up to 28 days of age via a solar powered fan system benefited calves after 42 days of age through the first lactation. Small differences for calves can provide more benefits later in survival and lactation.

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