Northern NY Agricultural Development Program
2016 Project Report APPENDIX

Feeding Strategies & Behavior of Heat-Stressed Calves in NNY

Table 1. Initial body weight (BW) and serum total protein for each treatment, Calf Heat Stress Study, Chazy, NY, May-September 2016.

	Treatment[1]				
Measurement	CON	FTEMP	FALL	SE	*P*-value
Number of calves	19	19	20		
Initial BW[2], lb (kg)	95.7 (43.4)	94.6 (42.9)	97.4 (44.2)	1.8 (0.8)	0.50
Serum total protein, g/dL	6.1	5.8	6.0	0.1	0.27

[1]Calves were fed 1 of 3 treatments: 1) milk replacer with no added fat (CON); 2) milk replacer with added fat on study days when daily temperature exceeded 78ºF (FTEMP), and 3) milk replacer with added fat for all study days (FALL).
[2]Initial BW was taken when calves were moved to individual hutches at 2 days of age.

Table 2. Data (mean ± standard error) characterizing the analyzed chemical composition of diet ingredients, Calf Heat Stress Study, Chazy, NY, May-September 2016.

Item	Milk Replacer[1]	Starter[2]	Milk Energizer[3] (Fat Source)
Composite samples, n	5	5	5
DM, %	91.4 ± 0.2	87.4 ± 0.1	95.5 ± 0.1
CP, % of DM	27.1 ± 0.2	25.9 ± 0.1	6.98 ± 0.07
Soluble protein, % CP	98.1 ± 0.2	17.4 ± 1.0	58.8 ± 1.8
ADF, % of DM	0.34 ± 0.02	13.3 ± 0.2	0.74 ± 0.07
aNDF, % of DM	0.74 ± 0.09	28.4 ± 0.6	1.64 ± 0.12
ME, Mcal/kg	4.76[4]	-	6.42[5]
NFC, % of DM	41.7 ± 0.3	37.3 ± 0.6	22.7 ± 0.3
Acid Hydrolysis Fat, % of DM	20.7 ± 0.3	-	63.8 ± 0.1
Ash, % of DM	9.84 ± 0.17	8.44 ± 0.10	4.95 ± 0.32
Calcium, % of DM	0.99 ± 0.02	0.96 ± 0.03	0.29 ± 0.00
Phosphorus, % of DM	0.79 ± 0.01	0.89 ± 0.01	0.38 ± 0.00
Magnesium, % of DM	0.14 ± 0.00	0.47 ± 0.01	0.05 ± 0.00
Potassium, % of DM	2.55 ± 0.02	1.60 ± 0.01	0.83 ± 0.01
Sodium, % of DM	0.97 ± 0.01	0.37 ± 0.02	0.52 ± 0.00
Iron, mg/kg	146 ± 4	267 ± 3	15.4 ± 1.2
Manganese, mg/kg	43.0 ± 1.2	134 ± 2	0.20 ± 0.20
Zinc, mg/kg	71.8 ± 0.9	131 ± 1	3.20 ± 0.20
Copper, mg/kg	15.0 ± 0.5	27.8 ± 0.6	0.20 ± 0.20

[1,2] Poulin Grain, Newport, VT.

[3]Milk Specialties Global, Eden Prairie, MN.

[4]ME was calculated using the following equation: ME = (0.057 * CP + 0.092 * fat + 0.0395 * lactose) * 0.93 (NRC, 2001). Lactose was calculated by subtracting CP, fat, and ash on a DM basis from 100 (Quigley, 2007).

[5]Personal communication (Jessica Raabe, Milk Specialties Global, Eden Prairie, MN, February 14, 2017).

Table 3. Intake and performance of calves fed three strategies of fat supplementation in milk replacer, Calf Heat Stress Study, Chazy, NY, May-September 2016.

	Treatment[1]				*P*-value	
Measurement	CON	FTEMP	FALL	SE	CON vs. Fat[2]	FTEMP vs. FALL
Preweaning[3]						
ADG, lb/d (kg/d)	1.92 (0.87)	2.03 (0.92)	2.07 (0.94)	0.04 (0.02)	**<0.01**	0.38
Milk replacer intake, lb/d (kg/d)	2.38 (1.08)	2.56 (1.16)	2.62 (1.19)	0.02 (0.01)	**<0.01**	**<0.01**
Starter intake, lb/d (g/d)	0.10 (46)	0.12 (54)	0.12 (55)	0.02 (9)	0.44	0.91
DMI, lb/d (kg/d)	2.49 (1.13)	2.69 (1.22)	2.76 (1.25)	0.02 (0.01)	**<0.01**	0.10
Water Intake, qrts/d (L/d)	2.13 (2.02)	2.57 (2.43)	2.21 (2.09)	0.22 (0.21)	0.36	0.26
Hip Height Change, inches (cm)	5.2 (13.2)	5.0 (12.7)	5.0 (12.8)	0.2 (0.6)	0.31	0.82
Hip Width Change, inches (cm)	2.2 (5.7)	2.3 (5.8)	2.2 (5.6)	0.04 (0.1)	0.96	0.17
Gain/Feed	0.77	0.76	0.75	0.01	0.46	0.93
Overall[4]						
ADG, lb/d (kg/d)	1.74 (0.79)	1.76 (0.80)	1.83 (0.83)	0.04 (0.02)	0.42	0.40
Milk replacer intake, lb/d (kg/d)	2.07 (0.94)	2.23 (1.01)	2.29 (1.04)	0.01 (0.00)	**<0.01**	**<0.01**
Starter intake, lb/d (g/d)	0.42 (189)	0.40 (181)	0.43 (193)	0.05 (22)	0.94	0.68
DMI, lb/d (kg/d)	2.49 (1.13)	2.62 (1.19)	2.71 (1.23)	0.04 (0.02)	**<0.01**	0.20
Water Intake, qrts/d (L/d)	2.60 (2.46)	3.0 (2.84)	2.72 (2.57)	0.25 (0.24)	0.42	0.44
Hip Height Change, inches (cm)	6.5 (16.6)	6.2 (15.8)	6.5 (16.4)	0.2 (0.5)	0.45	0.48
Hip Width Change, cm	2.7 (6.8)	2.8 (7.1)	2.8 (7.0)	0.1 (0.2)	0.26	0.75
Gain/Feed	0.70	0.67	0.67	0.01	**0.04**	0.85

[1]Calves were fed 1 of 3 treatments: 1) milk replacer with no added fat (CON); 2) milk replacer with added fat on study days when daily temperature exceeded 78ºF (FTEMP), and 3) milk replacer with added fat for all study days (FALL).
[2]Probability for contrast: CON vs Fat (FTEMP + FALL).
[3]Calves from 2 to 43 days of age receiving full amounts of milk.
[4]Calves from 2 to 57 days of age.

Table 4. LS means of body temperature, respiration rate and frequency of health events recorded daily based on categorization of health scores by feeding treatment, Calf Heat Stress Study, Chazy, NY, May-September 2016.

Measurement	Treatment[1]				*P*-value	
	CON	FTEMP	FALL	SE	CON vs. Fat[2]	FTEMP vs. FALL
Body Temperature, °F (°C)	102.4 (39.11)	102.5 (39.15)	102.5 (39.15)	0.03	0.25	0.92
Respiration, breaths/min	57	58	63	1	**0.04**	**0.02**
Treatment, d	3.3	3.2	2.5	-	0.69	0.60
Skin tent[3], % > 2 s	8.0	9.4	7.2	-	0.86	0.13
Eye Recession[4], % > 2 mm	2.3	1.6	1.5	-	0.99	0.97
Cough Score[5], % > 1	0	0	0	-	-	-
Nasal Discharge Score[5], % > 1	0.4	0.4	0.4	-	0.99	0.99
Fecal Score[5], % > 1	16.3	15.0	15.5	-	0.25	0.36

[1]Calves were fed 1 of 3 treatments: 1) milk replacer with no added fat (CON); 2) milk replacer with added fat on study days when daily temperature exceeded 78ºF (FTEMP), and 3) milk replacer with added fat for all study days (FALL).
[2]Probability for contrast: CON vs Fat (FTEMP + FALL).
[3] Bentley, 2012.
[4]Adapted from Wren, 2011.
[5]Adapted from Peña et al., 2016.

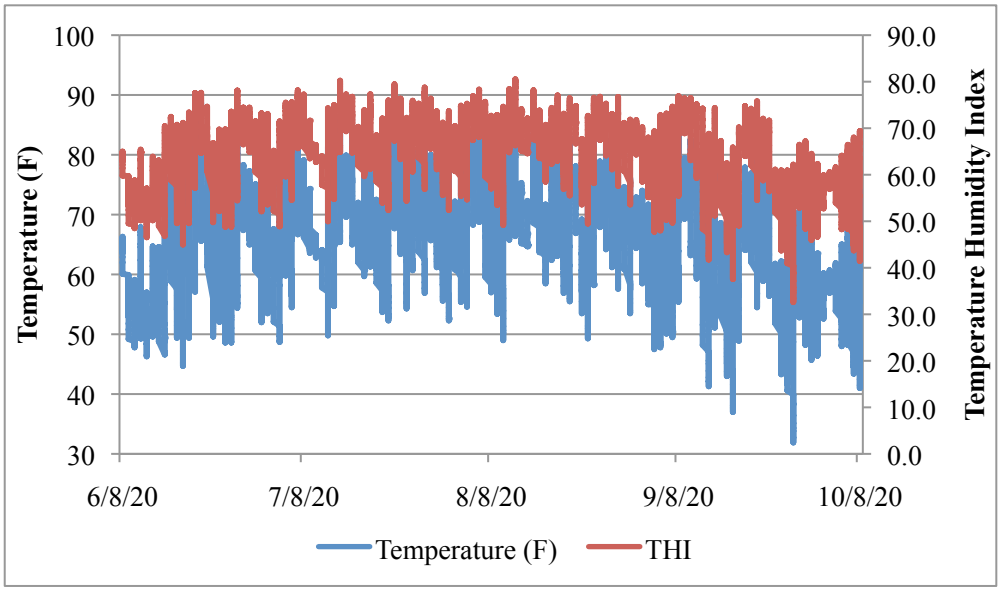

Figure 1. Average Temperature and Temperature Humidity Index by day over study period, Calf Heat Stress Study, Chazy, NY, May-September 2016.

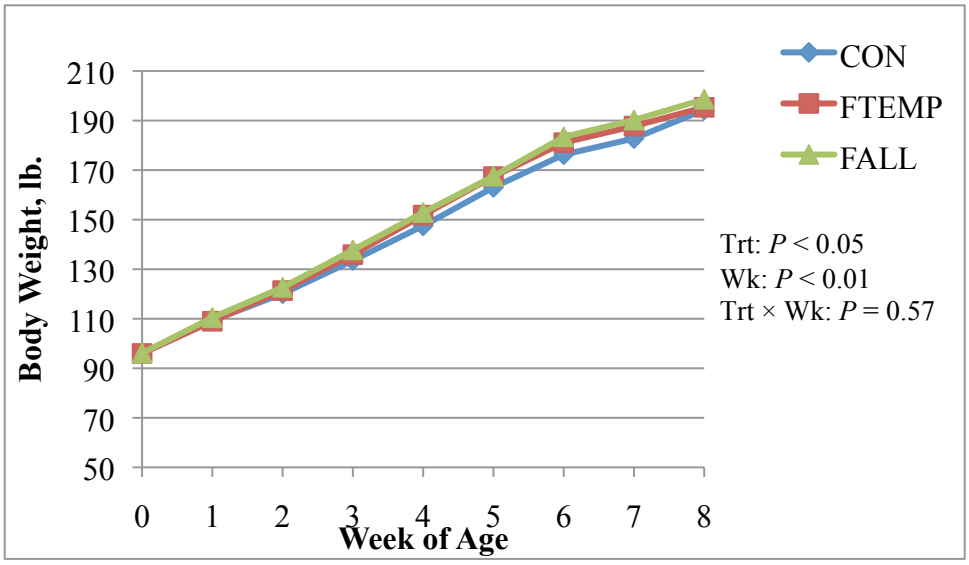

Figure 2. LS Mean body weight (lbs.) for calves fed three fat supplementation strategies from 0 - 8 weeks of age, Calf Heat Stress Study, Chazy, NY, May-September 2016.

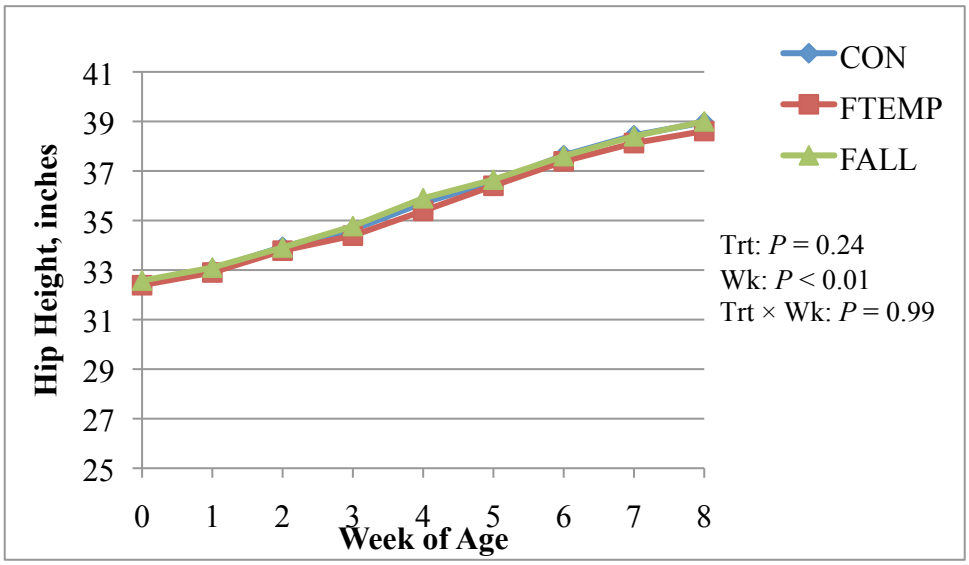

Figure 3. LS Mean hip height (inches) for calves fed three fat supplementation strategies from 0 - 8 weeks of age, Calf Heat Stress Study, Chazy, NY, May-September 2016.

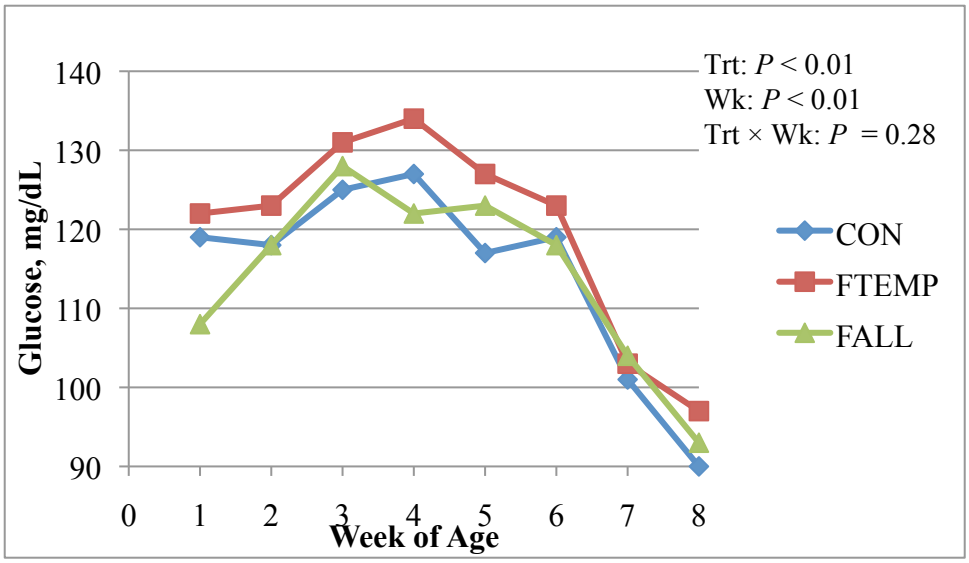

Figure 4. LS Mean plasma glucose (mg/dl) for calves fed three fat supplementation strategies from 0 - 8 weeks of age, Calf Heat Stress Study, Chazy, NY, May-September 2016.

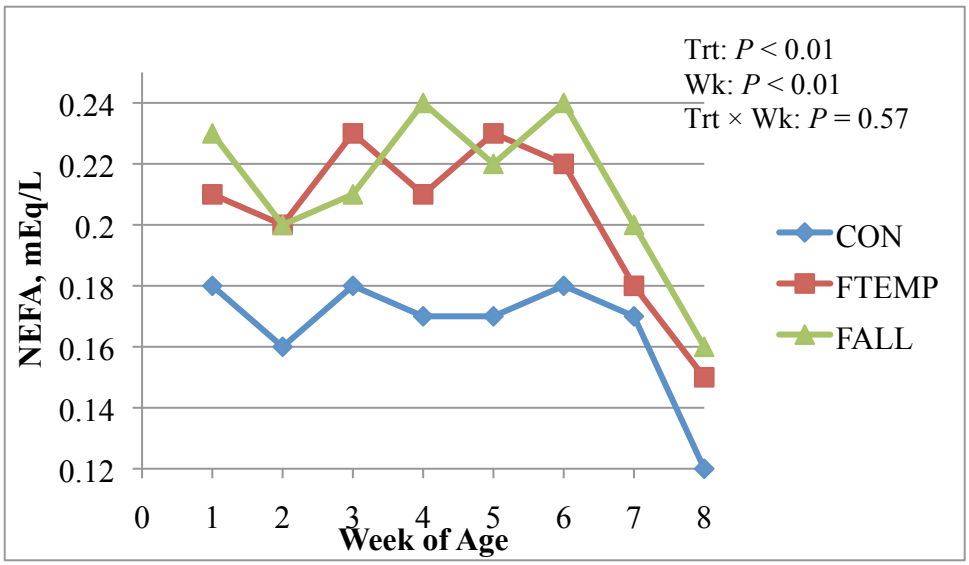

Figure 5. LS Mean plasma NEFA (mEq/L) for calves fed three fat supplementation strategies from 0 - 8 weeks of age, Calf Heat Stress Study, Chazy, NY, May-September 2016.

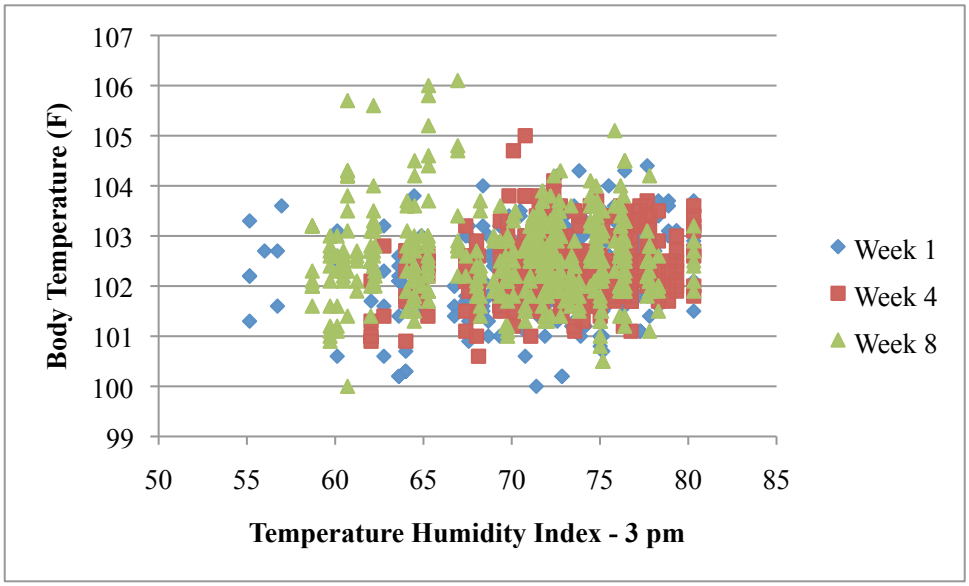

Figure 6. Relationship between temperature humidity index and body temperature of calves housed in hutches in Northern NY during the summer, measured at 3:00 pm daily, Calf Heat Stress Study, Chazy, NY, May-September 2016.

.

.

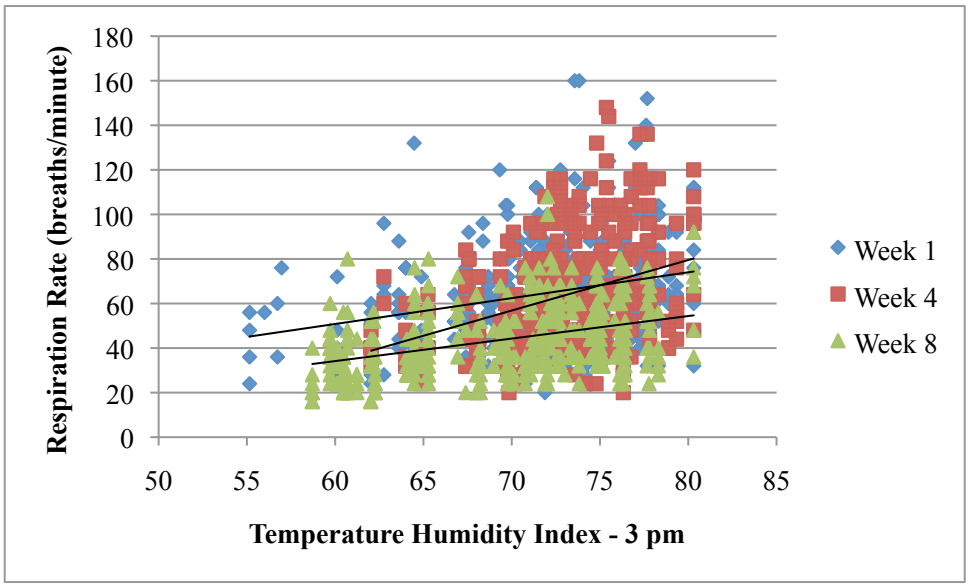

Figure 7. Relationship between temperature humidity index and respiration rate of calves housed in hutches in Northern NY during the summer, measured at 3:00 pm daily, Calf Heat Stress Study, Chazy, NY, May-September 2016.

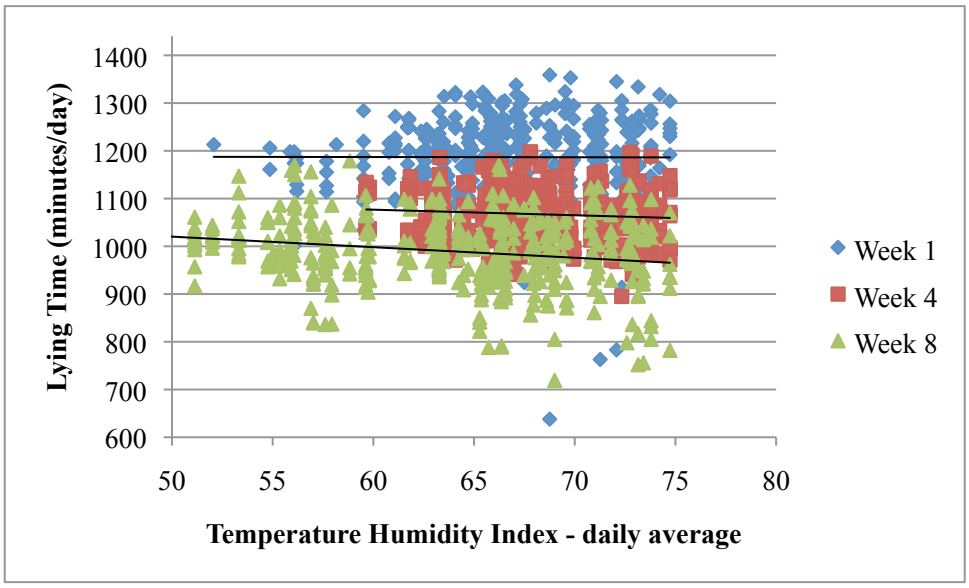

Figure 8. Relationship between temperature humidity index and lying time of calves housed in hutches in Northern NY during the summer, Calf Heat Stress Study, Chazy, NY, May-September 2016.

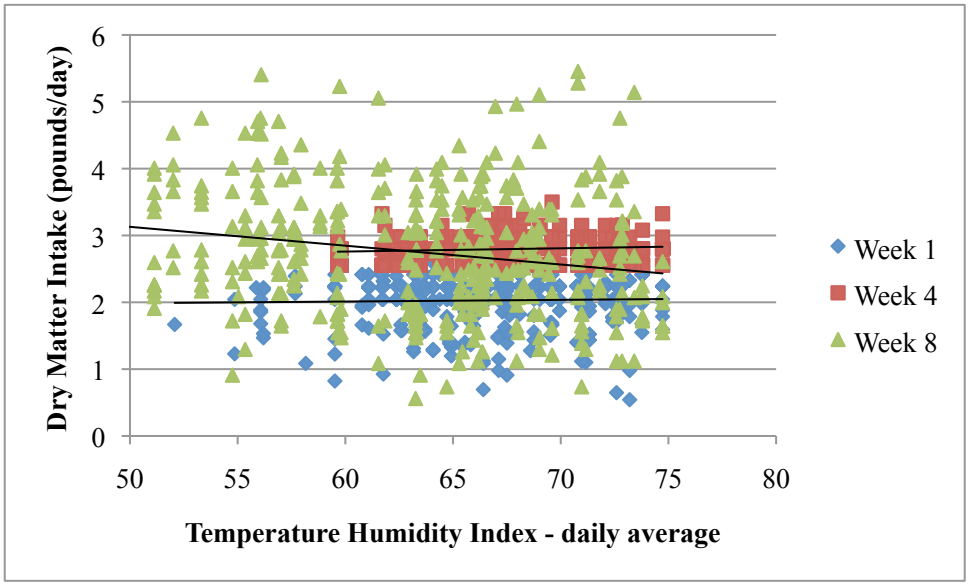

Figure 9. Relationship between temperature humidity index and dry matter intake of calves housed in hutches in Northern NY during the summer, Calf Heat Stress Study, Chazy, NY, May-September 2016.

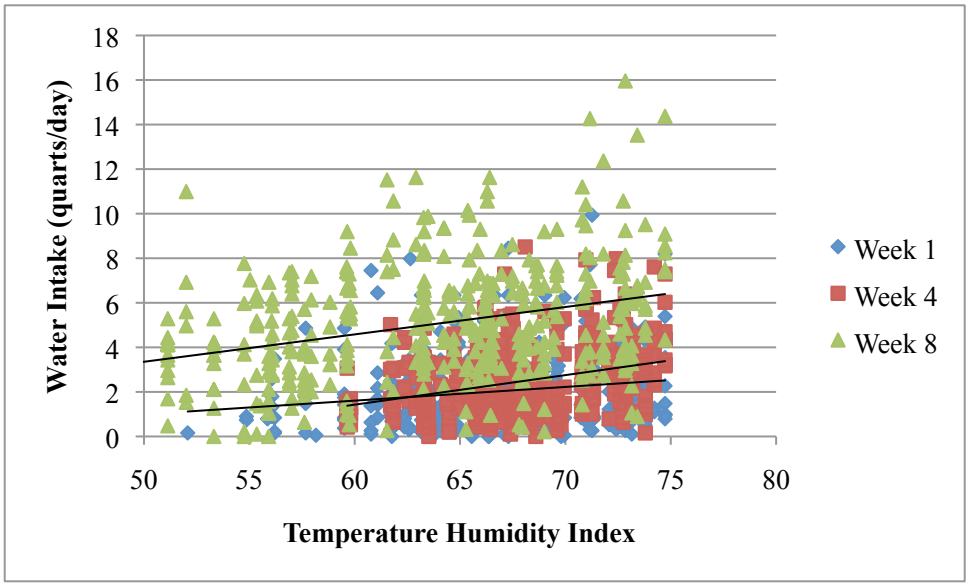

Figure 10. Relationship between temperature humidity index and free choice water intake of calves housed in hutches in Northern NY during the summer, Calf Heat Stress Study, Chazy, NY, May-September 2016.

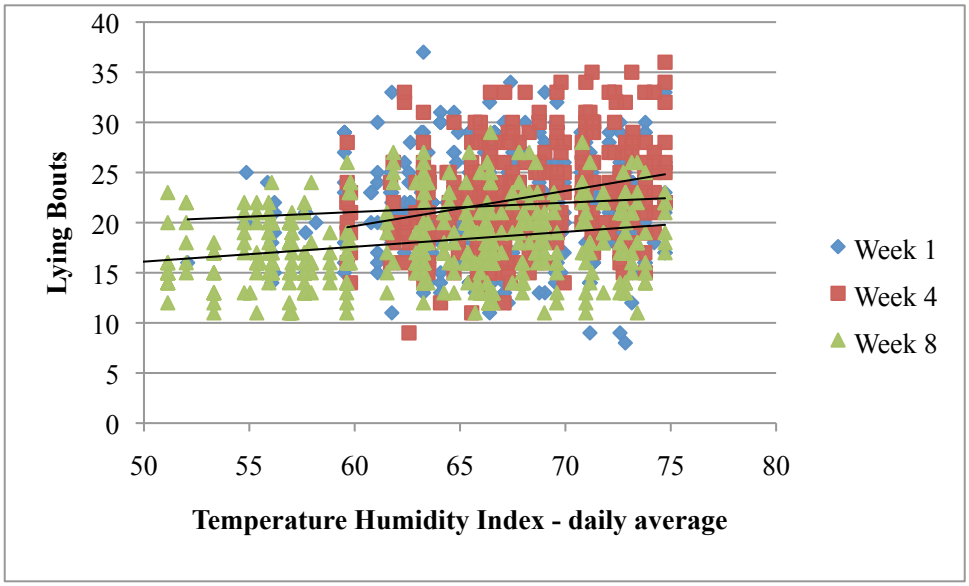

Figure 11. Relationship between Temperature Humidity Index and free choice water intake of calves housed in hutches in Northern NY; Calf Heat Stress Study, Chazy, NY, May-September 2016.