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Appendix

Table 1 Effects of heat stress on the changes of plasma volume, blood volume, ruminal fluid volume, half-life of PEG in rumen and outflow rate of ruminal fluid of six swamp buffaloes

parameter	condition	Buffalo number					
		1	2	3	4	5	6
Plasma Volume (L)	control	16.38	20.00	16.00	17.09	18.52	12.66
	heat	17.98	19.84	16.29	17.86	20.83	14.93
Plasma Volume (L/100 kg)	control	5.07	5.43	4.52	4.75	4.69	3.58
	heat	5.57	5.39	4.60	4.96	5.27	4.22
Blood Volume (L)	control	21.84	25.97	21.62	22.19	26.08	17.96
	heat	23.81	25.77	22.01	22.25	29.34	21.03
Blood Volume (L/100 kg)	control	6.76	7.06	6.11	6.16	6.60	5.07
	heat	7.37	7.00	6.22	6.18	7.43	5.94
Ruminal Fluid Volume (L)	control	27.59	20.00	20.00	55.56	20.00	28.57
	heat	58.82	36.36	68.97	40.00	50.00	14.29
Ruminal Fluid Volume (L/100 kg)	control	8.62	5.46	5.83	15.22	5.85	8.80
	heat	18.21	9.88	19.48	11.11	12.66	4.04
Half Life of Polyethylene Glycol (hr)	control	8.18	11.12	9.24	3.18	12.12	6.48
	heat	10.55	2.48	2.12	3.48	16.24	1.36
Outflow Rate of Ruminal Fluid (L/hr)	control	2.34	1.25	15.00	12.11	1.14	3.06
	heat	3.86	10.16	22.55	7.97	2.13	7.28

Table 2 Effects of heat stress on total body water, half-life of tritiated water and water turnover rate of six swamp buffaloes.

parameter	condition	Buffalo number					
		1	2	3	4	5	6
Total Body Water (L)	control	193.67	323.28	283.41	457.0	297.91	372.67
	heat	287.08	409.13	601.12	304.0	257.29	304.57
Total Body Water (L/100 kg)	control	60.52	88.33	82.63	125.21	87.11	114.84
	heat	88.88	111.18	169.81	84.44	65.14	86.04
Half Life of Tritiated Water (hr)	control	46.00	126.00	85.00	100.00	139.00	94.00
	heat	35.00	84.00	48.00	48.00	36.00	74.00
Water Turnover Rate (L/d)	control	70.00	42.67	85.00	76.01	35.65	65.94
	heat	136.40	226.82	208.29	105.34	118.87	68.45
Water Turnover Rate (L/100 kg/d)	control	21.88	11.66	24.78	20.82	10.42	20.32
	heat	42.23	61.64	58.84	29.26	30.09	19.34
Water Turnover Rate ($ml/kg^{0.82}/d$)	control	617.88	337.34	708.75	602.25	297.95	575.39
	heat	1,194.71	1,785.14	1,692.31	844.14	882.81	556.14

Table 3 Effects of heat stress on cardiorespiratory frequency, rectal temperature, packed cell volume, ruminal fluid concentration of PEG and ruminal fluid concentration of electrolytes of buffalo No 1 weighing 320.0 kgs on control period and 323.0 kgs on heat stress period.

parameter	condition	time (hour)						
		0	1	2	3	4	5	6
Environmental Temperature (^{o}C)	control	29.0	29.0	29.5	31.0	32.0	31.5	30.5
	heat	30.0	39.5	40.0	40.5	41.0	41.0	41.0
Relative humidity (%)	control	—	60.0	60.5	50.0	45.0	50.0	57.5
	heat	—	50.0	45.0	43.0	43.0	45.0	40.0
Respiration Rate (breath/min)	control	16.0	16.0	16.0	16.0	14.0	15.0	13.0
	heat	12.0	12.0	18.0	23.0	26.0	32.0	34.0
Heart Rate (beat/min)	control	30.0	30.0	32.0	34.0	37.0	38.0	40.0
	heat	40.0	40.0	40.0	40.0	45.0	55.0	56.0
Rectal Temperature (^{o}C)	control	38.3	38.3	38.35	38.4	38.45	38.5	38.6
	heat	38.7	38.8	38.8	39.1	39.3	39.5	39.4
Packed Cell Volume (%)	control	26.5	25.0	25.0	26.0	26.0	26.0	26.5
	heat	25.0	23.5	24.5	25.0	24.5	24.0	24.0
Ruminal Fluid Concentration of PEG (mg/ml)	control	—	1.364	0.961	1.713	1.022	1.445	0.863
	heat	—	0.631	0.493	0.484	0.531	0.478	—
Ruminal Fluid Concentration of Sodium (mEq/L)	control	128.0	105.0	94.0	113.0	128.0	115.0	127.0
	heat	141.0	140.0	142.0	146.0	146.0	145.0	147.0
Ruminal Fluid Concentration of potassium (mEq/L)	control	25.0	22.0	20.0	22.0	25.0	23.0	22.0
	heat	16.0	14.0	13.0	13.0	13.0	13.0	13.0
Ruminal Fluid Concentration of chloride (mEq/L)	control	14.3	12.3	11.9	12.4	14.4	12.1	13.4
	heat	13.4	13.2	14.2	15.0	15.8	15.5	15.4

Table 4 Effects of heat stress on plasma concentration of electrolytes, creatinine and aldosterone, urinary concentration of electrolytes and creatinine, urinary/plasma ratio of creatinine and fractional excretion of electrolytes of buffalo No 1.

parameter	condition	time (hour)						
		0	1	2	3	4	5	6
Plasma Concentration of Sodium (mEq/L)	control	133.0	129.0	131.0	132.0	131.0	130.0	130.0
	heat	126.0	127.0	126.0	124.0	124.0	127.0	124.0
Plasma Concentration of Potassium (mEq/L)	control	3.8	3.5	3.5	4.0	4.2	3.7	4.0
	heat	3.5	3.6	3.6	3.9	3.6	3.7	3.6
Plasma Concentration of Chloride (mEq/L)	control	89.0	95.0	87.0	90.0	97.0	94.0	93.0
	heat	93.0	96.0	98.0	94.0	94.0	99.0	96.0
Plasma Concentration of Creatinine (pg/ml)	control	28.13	15.00	26.25	22.50	25.32	29.07	26.25
	heat	23.45	27.19	19.69	20.45	21.00	22.50	22.50
Plasma Concentration of Aldosterone (ng/ml)	control	—	1.9	3.6	4.0	2.9	2.2	6.2
	heat	4.0	—	3.4	2.8	2.9	3.2	4.6
Urinary Concentration of Sodium (mEq/L)	control	6.0	16.0	10.0	14.0	14.0	8.0	8.0
	heat	16.0	20.0	18.0	22.0	72.0	86.0	74.0
Urinary Concentration of Potassium (mEq/L)	control	157.0	276.0	250.0	272.0	214.0	224.0	214.0
	heat	192.0	256.0	258.0	222.0	202.0	170.0	174.0
Urinary Concentration of Chloride (mEq/L)	control	103.0	105.0	129.0	103.0	99.0	99.0	57.0
	heat	263.0	210.0	190.0	123.0	114.0	120.0	88.0
Urinary Concentration of Creatinine (pg/ml)	control	450.0	1168.8	1562.5	1643.8	1987.8	2012.5	2025.0
	heat	987.5	1093.8	1287.5	1200.0	1312.5	1312.5	1327.5
Urinary Creatinine/Plasma Creatinine	control	16.00	77.92	59.52	73.06	78.51	69.23	77.14
	heat	42.12	48.27	65.37	58.69	62.50	58.33	59.00
Fractional Excretion of Sodium (%)	control	0.281	0.159	0.128	0.145	0.136	0.089	0.080
	heat	0.302	0.325	0.219	0.302	0.929	1.161	0.875
Fractional Excretion of Potassium (%)	control	258.25	161.21	120.01	93.07	64.86	87.45	69.35
	heat	198.08	147.33	109.63	96.98	89.78	78.78	81.92
Fractional Excretion of Chloride (%)	control	7.25	1.43	2.49	1.56	1.30	1.52	0.79
	heat	6.72	4.54	2.97	2.23	1.94	2.07	1.56

Table 5 Concentration of Evan's blue and count of tritiated water after correction of buffalo No 1 under control and heat stress periods.

time	concentration of Evan's blue (mg/ml)		count of tritiated water after correction (cpm)			
			control		heat	
	control	heat	Xc	Xc-control	Xc	Xc-control
20 min } control plasma volume		5.57				
30 min		5.21				
40 min		5.00				
60 min		5.27				
0 (control TOH)			108.69	0	105.76	0
20 min	6.42		18,399.79	18,291.10	11,985.94	11,880.18
25 min	6.15		—	—	—	—
35 min	5.05		—	—	—	—
40 min	—		11,162.99	11,054.29	5,627.71	5,521.95
60 min	5.68		—	—	9,800.87	9,695.11
2 hours			15,257.89	15,149.19	—	—
3 hours			3,843.64	3,734.94	5,779.98	5,674.22
4 hours			7,494.97	7,386.27	6,842.51	6,736.75
4.20 hours		5.67	—	—	—	—
4.30 hours		5.39	—	—	—	—
4.40 hours		5.29	—	—	—	—
5 hours		5.19	3,928.03	3,819.33	5,831.29	5,725.54
6 hours			5,190.26	5,081.56	5,422.96	5,317.20
20 hours			8,108.24	7,999.54	3,742.99	3,637.24
30 hours			6,988.90	6,880.20	6,462.27	6,356.51
44 hours			14,774.28	14,665.58	2,261.16	2,155.40
54 hours			4,928.56	4,819.86	2,931.84	2,826.11

Table 6 Effects of heat stress on cardiorespiratory frequency, rectal temperature, packed cell volume, ruminal fluid concentration of PEG and ruminal fluid concentration of electrolytes of buffalo No 2 weighing 366.0 kgs on control period and 368.0 kgs on heat stress period

parameter	condition	time (hour)						
		0	1	2	3	4	5	6
Environmental Temperature (^{o}C)	control	27.0	27.0	28.0	30.0	30.5	31.0	31.0
	heat	33.5	39.0	41.0	42.0	42.0	42.0	41.0
Relative humidity (%)	control	—	59.0	55.0	45.0	45.0	45.0	45.0
	heat	—	45.0	45.0	42.0	42.0	42.0	51.0
Respiration Rate (breath/min)	control	19.0	19.0	21.0	21.0	22.0	19.0	22.0
	heat	24.0	54.0	66.0	82.0	90.0	104.0	78.0
Heart Rate (beat/min)	control	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	heat	48.0	48.0	48.0	52.0	52.0	52.0	52.0
Rectal Temperature (^{o}C)	control	38.25	38.25	38.25	38.25	38.4	38.5	38.7
	heat	38.6	38.7	38.9	39.0	39.15	39.2	39.5
Packed Cell Volume (%)	control	22.5	22.0	22.0	22.0	21.0	22.0	22.0
	heat	23.0	23.0	22.5	23.0	23.0	23.0	23.0
Ruminal Fluid Concentration of PEG (mg/ml)	control	—	0.463	0.138	0.350	1.444	1.813	1.400
	heat	—	0.819	0.900	0.375	0.294	0.266	0.278
Ruminal Fluid Concentration of sodium (mEq/L)	control	110.0	111.0	109.0	89.0	107.0	104.0	106.0
	heat	117.0	134.0	136.0	137.0	113.0	135.0	131.0
Ruminal Fluid Concentration of potassium (mEq/L)	control	24.0	24.0	24.0	20.0	26.0	25.0	26.0
	heat	10.0	10.0	10.0	10.0	8.0	9.0	9.0
Ruminal Fluid Concentration of chloride (mEq/L)	control	11.2	10.4	10.5	13.0	13.8	11.8	12.3
	heat	10.2	11.0	12.0	11.3	10.0	11.7	11.4

Table 7 Effects of heat stress on plasma concentration of electrolytes, creatinine and aldosterone, urinary concentration of electrolytes and creatinine, urinary/plasma ratio of creatinine and fractional excretion of electrolytes of buffalo No 2.

parameter	condition	time (hour)						
		0	1	2	3	4	5	6
Plasma Concentration of Sodium (mEq/L)	control	131.0	129.0	128.0	132.0	131.0	131.0	128.0
	heat	123.0	130.0	127.0	127.0	127.0	131.0	131.0
Plasma Concentration of Potassium (mEq/L)	control	4.6	4.5	4.4	4.0	3.8	3.8	3.8
	heat	4.0	4.1	4.1	4.0	3.9	4.1	4.0
Plasma Concentration of Chloride (mEq/L)	control	100.0	99.0	97.0	95.0	97.0	98.0	104.0
	heat	94.0	100.0	100.0	100.0	93.0	104.0	100.0
Plasma Concentration of Creatinine (pg/ml)	control	24.95	—	18.19	22.04	21.00	20.63	17.82
	heat	19.69	19.69	20.63	28.50	22.97	25.32	27.57
Plasma Concentration of Aldosterone (ng/ml)	control	—	5.8	—	4.6	—	4.8	—
	heat	4.0	—	5.8	5.3	4.3	4.1	4.1
Urinary Concentration of Sodium (mEq/L)	control	15.0	18.0	20.0	14.0	32.0	17.5	18.0
	heat	34.0	98.0	42.0	22.0	18.0	22.0	30.0
Urinary Concentration of Potassium (mEq/L)	control	417.5	392.0	392.0	388.0	362.0	425.0	392.0
	heat	168.0	234.0	252.0	284.0	296.0	268.0	222.0
Urinary Concentration of Chloride (mEq/L)	control	206.0	230.0	235.0	231.0	216.0	252.0	257.0
	heat	309.0	271.0	277.0	308.0	285.0	254.0	255.0
Urinary Concentration of Creatinine (pg/ml)	control	978.1	893.8	937.5	918.8	946.9	1,446.9	1,440.6
	heat	550.0	737.5	1,068.8	1,531.3	1,706.3	1,850.0	2,225.0
Urinary Creatinine/Plasma Creatinine	control	39.21	—	51.53	41.69	45.09	70.15	80.84
	heat	27.93	37.45	51.82	53.73	74.30	73.06	80.70
Fractional Excretion of Sodium (%)	control	0.293	—	0.303	0.254	0.541	0.191	0.174
	heat	0.988	2.013	0.639	0.322	0.191	0.229	0.284
Fractional Excretion of Potassium (%)	control	231.47	—	172.89	232.67	221.27	159.43	127.61
	heat	150.38	152.39	118.60	235.53	102.14	89.47	68.77
Fractional Excretion of Chlroride (%)	control	5.25	—	4.70	5.83	4.95	3.66	3.06
	heat	11.78	7.24	5.35	5.73	4.13	3.34	3.16

Table 8 Concentration of Evan's blue and count of tritiated water after correction of buffalo No 2 under control and heat stress periods.

time	concentration of Evan's blue (mg/ml)		count of tritiated water after correction (cpm)			
			control		heat	
	control	heat	Xc	Xc-control	Xc	Xc-control
20 min } control plasma volume		4.44				
30 min		4.64				
40 min		4.59				
50 min		5.04				
0 (control TOH)			103.73	0	97.32	0
20 min	6.33		7,781.35	7,677.62	7,713.33	7,616.01
30 min	6.10		—	—	—	—
40 min	5.89		7,736.41	7,632.68	5,835.02	5,737.70
60 min	5.57		9,160.65	9,056.92	6,237.78	6,140.46
2 hours			7,849.85	7,746.12	6,256.66	6,159.34
3 hours			7,896.05	7,792.32	6,898.38	6,892.06
4 hours			5,897.82	5,794.09	8,656.79	8,559.47
4.20 hours		5.45	—	—	—	—
4.30 hours		5.66	—	—	—	—
4.40 hours		5.86	—	—	—	—
5 hours		5.29	5,358.82	5,255.09	5,536.32	5,439.00
6 hours			6,178.63	6,074.90	4,934.69	4,837.38
20 hours			4,952.34	4,848.61	4,930.53	4,293.38
30 hours			5,104.89	5,001.16	4,590.53	4,493.21
40 hours			3,939.68	3,835.95	4,002.29	3,904.97
54 hours			4,095.61	3,991.88	3,198.15	3,100.83

Table 9 Effects of heat stress on cardiorespiratory frequency, rectal temperature, packed cell volume, ruminal fluid concentration of PEG and ruminal fluid concentration of electrolytes of buffalo No 3 weighing 343.0 kgs on control and 354.0 kgs on heat stress period.

parameter	condition	time (hour)						
		0	1	2	3	4	5	6
Environmental Temperature (^{o}C)	control	29.0	29.0	30.5	32.5	33.0	32.5	32.5
	heat	34.0	40.0	42.0	41.0	42.0	42.0	42.0
Relative Humidity (%)	control	—	53.5	44.5	41.0	41.0	40.5	45.0
	heat	—	45.0	42.0	41.0	42.0	42.0	42.0
Respiration Rate (breath/min)	control	22.0	22.0	22.0	18.0	23.0	17.0	20.0
	heat	26.0	80.0	94.0	100.0	110.0	98.0	84.0
Heart Rate (beat/min)	control	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	heat	46.0	48.0	51.0	58.0	56.0	54.0	50.0
Rectal Temperature (^{o}C)	control	38.2	38.2	38.2	38.2	38.2	38.2	38.2
	heat	38.55	38.7	39.1	39.3	39.3	39.9	39.9
Packed Cell Volume (%)	control	26.0	26.0	26.5	26.0	26.5	26.0	26.0
	heat	26.0	26.0	26.0	26.0	26.0	26.0	26.0
Ruminal Fluid Concentration of PEG (mg/ml)	control	—	1.850	1.988	1.700	1.400	1.369	1.825
	heat	—	0.175	0.306	0.344	0.113	—	0.088
Ruminal Fluid Concentration of sodium (mEq/L)	control	94.0	50.0	66.0	74.0	96.0	76.0	77.0
	heat	114.0	103.0	121.0	121.0	120.0	123.0	126.0
Ruminal Fluid Concentration of potassium (mEq/L)	control	32.0	17.0	22.0	24.0	31.0	25.0	26.0
	heat	15.0	14.0	14.0	15.0	15.0	14.0	15.0
Ruminal Fluid Concentration of chloride (mEq/L)	control	10.6	5.9	9.1	10.0	11.2	9.9	9.0
	heat	12.9	10.4	14.5	12.3	12.5	13.0	13.0

Table 10 Effects of heat stress on plasma concentration of electrolytes, creatinine and aldosterone, urinary concentration of electrolytes and creatinine, urinary/plasma ratio of creatinine and fractional excretion of electrolytes of buffalo No. 3

parameter	condition	time (hour)						
		0	1	2	3	4	5	6
Plasma Concentration of Sodium (mEq/L)	control	126.0	126.0	127.0	124.0	135.0	139.0	143.0
	heat	124.0	124.0	124.0	121.0	123.0	123.0	126.0
Plasma Concentration of Potassium (mEq/L)	control	5.3	5.4	5.2	4.8	5.6	5.4	5.4
	heat	4.3	4.4	4.3	4.3	4.3	4.2	4.6
Plasma Concentration of Chloride (mEq/L)	control	101.0	99.0	96.0	98.0	98.0	98.0	96.0
	heat	101.0	92.0	93.0	92.0	94.0	96.0	99.0
Plasma Concentration of Creatinine (pg/ml)	control	23.16	22.88	—	20.16	21.09	17.82	18.75
	heat	22.50	24.57	24.38	23.45	25.32	26.25	26.25
Plasma Concentration of Aldosterone (ng/ml)	control	—	215.0	205.0	180.0	200.0	225.0	225.0
	heat	40.0	—	90.0	134.0	105.0	162.0	141.0
Urinary Concentration of Sodium (mEq/L)	control	4.0	4.0	—	8.0	12.0	4.0	4.0
	heat	12.0	6.0	3.0	3.0	3.0	1.0	1.0
Urinary Concentration of Potassium (mEq/L)	control	360.0	362.0	—	334.0	328.0	234.0	302.0
	heat	250.0	288.0	324.0	302.0	316.0	278.0	286.0
Urinary Concentration of Chloride (mEq/L)	control	221.0	247.0	—	229.0	237.0	243.0	199.0
	heat	263.0	260.0	257.0	282.0	274.0	301.0	297.0
Urinary Concentration of Creatinine (pg/ml)	control	656.3	543.8	—	537.5	681.3	725.0	703.1
	heat	637.5	762.5	901.3	1,125.0	1,468.8	1,493.8	1,562.5
Urinary Creatinine/Plasma Creatinine	control	28.34	23.77	—	26.66	32.30	40.68	37.49
	heat	28.33	31.03	36.98	47.92	58.01	56.91	59.52
Fractional Excretion of Sodium (%)	control	0.113	0.135	—	0.244	0.276	0.071	0.075
	heat	0.342	0.155	0.065	0.052	0.041	0.014	0.012
Fractional Excretion of Potassium (%)	control	239.66	282.04	—	260.99	181.33	106.51	149.15
	heat	205.22	210.92	203.76	146.56	126.56	116.31	104.45
Fractional Excretion of Chloride (%)	control	7.73	10.52	—	8.78	7.49	6.10	5.52
	heat	9.18	9.02	7.46	6.41	5.03	5.52	5.04

Table 11 Concentration of Evan's blue and count of tritiated water after correction of buffalo No 3 under control and heat stress periods.

time		concentration of Evan's blue (mg/ml)		count of tritiated water after correction (cpm)			
				control		heat	
		control	heat	Xc	Xc-control	Xc	Xc-control
30 min	control plasma volume		4.41				
40 min			4.58				
50 min			4.91				
60 min			4.62				
0 (control TOH)				979.84	0	3,234.76	0
20 min		6.46		11,716.43	10,736.16	11,384.69	8,149.93
30 min		6.10		—	—	—	—
40 min		5.89		7,793.21	6,813.37	11,461.49	8,226.73
60 min		5.62		11,004.79	10,024.96	7,253.70	4,018.94
2 hours				28,104.99	27.125.15	7,857.53	4,622.77
3 hours				7,869.77	6,889.93	6,172.54	2,937.78
4 hours				6,555.85	5,576.00	7,078.69	2,843.93
4.30 hours			5.98	—	—	—	—
4.40 hours			5.36	—	—	—	—
4.50 hours			5.82	—	—	—	—
5 hours			5.07	8,326.85	7,347.01	6,363.17	3,128.41
6 hours				7,027.82	6,047.98	6,482.94	3,248.18
20 hours				7,544.53	6,564.69	4,842.28	1,607.52
30 hours				5,853.31	4,873.41	7,146.43	3,911.67
44 hours				5,905.64	4,925.80	4,927.88	1,693.12
54 hours				4,922.23	3,942.39	4,586.11	1,351.34

Table 12 Effect of heat stress on cardiorespiratory frequency, rectal temperature, packed cell volume, ruminal fluid concentration of PEG and ruminal fluid concentration of electrolytes of buffalo No 4 weighing 365.0 kgs on control and 360.0 kgs on heat stress period.

parameter	condition	time (hour)						
		0	1	2	3	4	5	6
Environmental Temperature (^{o}C)	control	27.0	27.0	30.0	31.5	32.5	32.5	33.0
	heat	33.0	37.0	39.0	40.0	41.5	42.0	42.0
Relative Humidity (%)	control	—	74.0	50.0	53.0	45.0	45.0	41.0
	heat	—	53.0	54.0	55.0	53.0	42.0	42.0
Respiration Rate (breath/min)	control	25.0	25.0	21.0	36.0	34.0	27.0	30.0
	heat	44.0	50.0	55.0	66.0	108.0	120.0	94.0
Heart Rate (beat/min)	control	40.0	40.0	40.0	40.0	38.0	38.0	38.0
	heat	50.0	50.0	50.0	50.0	54.0	55.0	36.0
Rectal Temperature (^{o}C)	control	38.0	38.0	38.0	38.0	38.0	37.9	38.2
	heat	38.5	38.8	38.9	39.5	40.1	40.5	40.7
Packed Cell Volume (%)	control	19.0	18.0	18.0	18.5	18.5	18.5	19.0
	heat	23.0	22.5	22.0	24.0	20.0	16.0	16.0
Ruminal Fluid Concentration of PEG (mg/ml)	control	—	0.575	0.063	0.325	—	0.338	0.200
	heat	—	1.400	0.475	—	—	0.503	0.252
Ruminal Fluid Concentration of sodium (mEq/L)	control	98.0	104.0	99.0	119.0	119.0	111.0	118.0
	heat	128.0	116.0	130.0	132.0	137.0	137.0	135.0
Ruminal Fluid Concentration of potassium (mEq/L)	control	28.0	27.0	26.0	29.0	30.0	30.0	32.0
	heat	27.0	25.0	25.0	24.0	22.0	24.0	26.0
Ruminal Fluid Concentration of chloride (mEq/L)	control	17.7	16.2	15.8	16.7	16.6	16.8	17.2
	heat	14.2	13.3	14.6	15.0	14.9	15.4	16.8

Table 13 Effects of heat stress on plasma concentration of electrolytes, creatinine and aldosterone, urinary concentration of electrolytes and creatinine, urinary/plasma ratio of creatinine and fractional excretion of electrolytes of buffalo No. 4

parameter	condition	time (hour)						
		0	1	2	3	4	5	6
Plasma Concentration of Sodium (mEq/L)	control	140.0	146.0	147.0	132.0	133.0	130.0	133.0
	heat	127.0	129.0	129.0	127.0	126.0	127.0	–
Plasma Concentration of Potassium (mEq/L)	control	5.0	5.1	5.0	4.5	4.3	4.3	4.3
	heat	4.3	4.6	4.4	4.5	4.3	4.1	–
Plasma Concentration of Chloride (mEq/L)	control	98.0	98.0	99.0	94.0	93.0	98.0	100.0
	heat	97.0	97.0	93.0	100.0	97.0	96.0	–
Plasma Concentration of Creatinine (pg/ml)	control	20.63	21.09	–	22.04	21.00	22.88	–
	heat	27.19	–	22.5	26.25	30.0	31.88	25.79
Plasma Concentration of Aldosterone (ng/ml)	control	–	5.7	–	5.0	–	4.2	–
	heat	6.8	5.8	4.6	4.2	3.2	5.3	–
Urinary Concentration of Sodium (mEq/L)	control	82.0	74.0	–	108.0	88.0	82.0	–
	heat	48.0	22.0	24.0	30.0	30.0	32.0	–
Urinary Concentration of Potassium (mEq/L)	control	166.0	134.0	–	142.0	118.0	150.0	–
	heat	156.0	148.0	170.0	184.0	180.0	172.0	–
Urinary Concentration of Chloride (mEq/L)	control	130.0	124.0	–	132.0	135.0	144.0	–
	heat	140.0	129.0	118.0	103.0	103.0	110.0	–
Urinary Concentration of Creatinine (pg/ml)	control	1,462.0	453.1	–	443.8	581.3	725.0	–
	heat	400.0	375.0	287.5	500.0	631.3	437.5	675.0
Urinary Creatinine/Plasma Creatinine	control	70.19	21.48	–	20.14	27.68	31.69	–
	heat	14.71	16.46	12.78	19.05	21.04	13.73	26.18
Fractional Excretion of Sodium (%)	control	0.826	2.360	–	4.060	2.390	1.990	–
	heat	2.569	1.338	0.976	1.112	1.733	0.963	–
Fractional Excretion of Potassium (%)	control	46.82	122.29	–	156.70	99.13	110.07	–
	heat	246.63	251.72	202.78	194.34	304.88	160.24	–
Fractional Excretion of Chloride (%)	control	1.89	5.91	–	6.95	5.24	4.64	–
	heat	9.79	8.08	9.94	5.41	5.04	8.38	–

Table 14 Concentration of Evan's blue and count of tritiated water after correction of buffalo No 4 under control and heat stress periods.

time	concentration of Evan's blue (mg/ml)		count of tritiated water after correction (cpm)			
			control		heat	
	control	heat	Xc	Xc-control	Xc	Xc-control
30 min } control		5.41				
40 min } plasma		5.39				
50 min } volume		5.09				
0 (control TOH)			101.27	0	91.20	0
20 min	5.52		8,883.12	8,781.85	6,352.99	6,251.79
30 min	5.39		—	—	4,725.14	4,633.94
40 min	5.08		3,480.30	3,379.13	—	—
60 min	4.96		2,911.70	2,810.43	5,139.09	5,047.89
2 hours			3,956.64	3,855.37	4,100.83	4,009.63
3 hours			3,311.19	3,209.92	4,501.94	4,410.74
3.30 hours		5.34	—	—	—	—
3.40 hours		5.13	—	—	—	—
4 hours		5.07	3,156.89	3,055.62	4,039.25	3,948.05
5 hours			3,053.27	2,951.99	2,269.38	2,178.18
6 hours			2,412.53	2,311.26	—	—
20 hours			2,613.51	2,512.24	3,788.98	3,697.78
30 hours			2,259.52	2,158.25	3,391.62	3,300.42
44 hours			2,387.06	2,285.79	2,699.75	2,608.55
54 hours			2,300.87	2,199.60	2,274.95	2,183.75

Table 15 Effects of heat stress on cardiorespiratory frequency, rectal temperature, packed cell volume, ruminal fluid concentration of PEG and ruminal fluid concentration of electrolytes of buffalo No 5 weighing 342.0 kgs on control and 395.0 kgs on heat stress period.

parameter	condition	time (hour)						
		0	1	2	3	4	5	6
Environmental Temperature (^{o}C)	control	30.5	30.5	32.0	33.0	33.0	33.0	33.0
	heat	34.0	41.0	41.0	41.0	41.0	42.0	42.0
Relative Humidity (%)	control	—	61.0	50.0	45.0	51.0	56.0	57.0
	heat	—	51.0	41.0	41.0	41.0	40.0	40.0
Respiration Rate (breath/min)	control	21.0	21.0	20.0	20.0	20.0	24.0	24.0
	heat	24.0	48.0	94.0	114.0	111.0	118.0	116.0
Heart Rate (beat/min)	control	50.0	50.0	50.0	50.0	50.0	50.0	50.0
	heat	33.0	50.0	50.0	64.0	54.0	50.0	50.0
Rectal Temperature (^{o}C)	control	38.6	38.6	38.6	38.6	38.6	38.6	39.1
	heat	38.6	38.8	39.1	39.4	39.4	39.6	39.6
Packed Cell Volume (%)	control	24.0	24.5	25.0	25.0	25.0	25.5	25.0
	heat	29.0	29.0	29.0	29.0	29.0	29.0	29.0
Ruminal Fluid Concentration of PEG (mg/ml)	control	—	0.588	1.700	1.540	1.563	0.500	—
	heat	—	0.563	0.606	0.659	0.669	0.663	0.688
Ruminal Fluid Concentration of sodium (mEq/L)	control	98.0	96.0	90.0	106.0	97.0	107.0	115.0
	heat	125.0	110.0	131.0	126.0	125.0	134.0	133.0
Ruminal Fluid Concentration of potassium (mEq/L)	control	32.0	37.0	34.0	34.0	32.0	38.0	31.0
	heat	29.0	23.0	23.0	21.0	22.0	24.0	22.0
Ruminal Fluid Concentration of chloride (mEq/L)	control	26.5	29.7	27.5	28.1	24.9	28.8	27.7
	heat	17.5	18.0	16.9	18.5	16.7	18.1	17.8

Table 16 Effects of heat stress on plasma concentration of electrolytes, creatinine and aldosterone, urinary concentration of electrolytes and creatinine, urinary/plasma ratio of creatinine and fractional excretion of electrolytes of buffalo No. 5

parameter	condition	time (hour)						
		0	1	2	3	4	5	6
Plasma Concentration of Sodium (mEq/L)	control	128.0	130.0	130.0	130.0	128.0	128.0	127.0
	heat	126.0	128.0	128.0	129.0	130.0	128.0	131.0
Plasma Concentration of Potassium (mEq/L)	control	4.1	4.3	4.2	4.6	4.4	4.3	4.1
	heat	3.4	3.7	3.6	3.8	4.0	3.9	3.9
Plasma Concentration of Chloride (mEq/L)	control	95.0	96.0	94.0	98.0	97.0	99.0	98.0
	heat	97.0	93.0	96.0	92.0	92.0	92.0	93.0
Plasma Concentration of Creatinine (pg/ml)	control	18.75	17.34	13.13	16.88	20.63	17.82	20.63
	heat	33.75	35.70	32.82	34.69	32.25	37.50	37.50
Plasma Concentration of Aldosterone (ng/ml)	control	—	15.0	—	52.0	—	—	—
	heat	17.0	—	10.0	7.0	27.5	18.0	9.0
Urinary Concentration of Sodium (mEq/L)	control	62.0	18.0	20.0	8.0	8.0	8.0	10.0
	heat	32.0	18.0	6.0	8.0	4.0	4.0	4.0
Urinary Concentration of Potassium (mEq/L)	control	260.0	272.0	314.0	238.0	238.0	314.0	326.0
	heat	218.0	278.0	358.0	334.0	314.0	304.0	294.0
Urinary Concentration of Chloride (mEq/L)	control	208.0	205.0	187.0	206.0	246.0	255.0	279.0
	heat	182.0	203.0	122.0	106.0	87.0	70.0	66.0
Urinary Concentration of Creatinine (pg/ml)	control	593.8	862.5	718.8	1,025.0	950.0	746.9	1,250.0
	heat	450.0	581.3	793.8	1,100.0	1,253.8	1,087.5	1,275.0
Urinary Creatinine/Plasma Creatinine	control	31.67	49.74	54.77	60.74	46.06	41.91	60.61
	heat	13.33	16.28	24.19	31.70	38.88	29.0	34.00
Fractional Excretion of Sodium (%)	control	1.528	0.277	0.281	0.102	0.137	0.150	0.130
	heat	1.905	0.866	0.194	0.196	0.079	0.107	0.091
Fractional Excretion of Potassium (%)	control	200.22	127.18	136.49	85.18	117.43	174.23	131.18
	heat	481.02	461.55	411.08	227.26	201.90	268.79	221.71
Fractiona Excretion of Chloride (%)	control	6.92	4.30	3.63	3.46	5.52	6.16	4.70
	heat	14.10	13.39	5.25	3.63	2.44	2.62	12.09

Table 17 Concentration of Evan's blue and count of tritiated water after correction of buffalo No 5 under control and heat stress periods.

time	concentration of Evan's blue (mg/ml)		count of tritiated water after correction (cpm)			
			control		heat	
	control	heat	Xc	Xc-control	Xc	Xc-control
30 min (control plasma volume)		5.03				
40 min (control plasma volume)		4.98				
50 min (control plasma volume)		4.79				
60 min (control plasma volume)		4.75				
0 (control TOH)			468.95	0	504.67	0
20 min	6.19		11,676.01	11,207.06	5,529.08	5,024.41
30 min	5.79		–	–	–	–
40 min	5.64		8,818.62	8,349.67	9,003.71	8,499.04
60 min	5.50		6,263.84	5,794.89	9,208.04	8,703.37
2 hours			8,105.89	7,636.95	8,186.17	7,681.50
3 hours			7,734.25	7,265.30	4,941.79	4,437.12
4 hours			8,010.97	7,542.02	5,951.93	5,447.26
4.30 hours		4.40	–	–	–	–
4.40 hours		4.39	–	–	–	–
4.50 hours		4.21	–	–	–	–
5 hours		4.07	7,769.76	7,300.81	7,736.11	7,231.44
6 hours			8,015.97	7,547.02	4,523.73	4,019.06
20 hours			6,478.18	6,009.23	5,415.52	4,910.85
30 hours			5,626.69	5,157.75	3,812.80	3,308.13
44 hours			5,563.22	5,094.27	3,494.41	2,989.74
54 hours			4,877.32	4,408.37	3,955.51	3,450.84

Table 18 Effects of heat stress on cardiorespiratory frequency, rectal temperature, packed cell volume, ruminal fluid concentration of PEG and ruminal fluid concentration of electrolytes of buffalo No 6 weighing 324.5 kgs on control and 354.0 kgs on heat stress period.

parameter	condition	time (hour)						
		0	1	2	3	4	5	6
Environmental Temperature (^{o}C)	control	30.5	30.5	31.0	32.5	34.0	35.5	36.0
	heat	35.5	40.0	40.0	42.0	42.0	45.0	44.0
Relative Humidity (%)	control	—	45.0	52.0	45.0	38.0	37.0	38.0
	heat	—	45.0	41.0	41.0	41.0	40.0	42.0
Respiration Rate (breath/min)	control	25.0	25.0	24.0	26.0	25.0	32.0	28.0
	heat	28.0	32.0	40.0	54.0	48.0	44.0	68.0
Heart Rate (beat/min)	control	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	heat	44.0	44.0	45.0	44.0	48.0	44.0	47.0
Rectal Temperature (^{o}C)	control	38.6	38.6	38.6	38.6	38.5	38.7	38.6
	heat	39.1	39.1	39.2	39.4	39.4	39.6	39.7
Packed Cell Volume (%)	control	30.5	27.0	28.5	27.5	30.5	27.0	28.0
	heat	29.5	28.0	29.5	28.5	29.0	28.5	29.0
Ruminal Fluid Concentration of PEG (mg/ml)	control	—	0.775	1.169	1.041	1.250	0.403	0.838
	heat	—	1.203	1.200	0.919	0.488	0.250	0.150
Ruminal Fluid Concentration of sodium (mEq/L)	control	119.0	124.0	136.0	123.0	129.0	128.0	124.0
	heat	115.0	103.0	112.0	115.0	108.0	121.0	120.0
Ruminal Fluid Concentration of potassium (mEq/L)	control	19.0	16.0	16.0	18.0	19.0	20.0	15.0
	heat	32.0	29.0	31.0	29.0	30.0	27.0	31.0
Ruminal Fluid Concentration of chloride (mEq/L)	control	11.6	11.6	13.2	11.2	11.7	11.1	11.7
	heat	17.2	16.0	17.5	17.3	16.9	17.0	17.2

Table 19 Effects of heat stress on plasma concentration of electrolytes, creatinine and aldosterone, urinary concentration of electrolytes ans creatinine, urinary/plasma ratio of creatinine and fractional excretion of electrolytes of buffalo No. 6

Parameter	condition	time (hour)						
		0	1	2	3	4	5	6
Plasma Concentration of Sodium (mEq/L)	control	127.0	130.0	130.0	128.0	129.0	126.0	129.0
	heat	127.0	125.0	126.0	128.0	124.0	123.0	124.0
Plasma Concentration of Potassium (mEq/L)	control	4.4	4.3	4.0	4.0	4.1	4.0	3.9
	heat	4.3	3.9	3.8	3.9	3.9	3.8	3.8
Plasma Concentration of Chloride (mEq/L)	control	93.0	89.0	95.0	93.0	92.0	92.0	88.0
	heat	92.0	92.0	98.0	101.0	93.0	91.0	93.0
Plasma Concentration of Creatinine (pg/ml)	control	17.82	14.07	13.59	13.59	13.59	13.59	15.00
	heat	31.88	30.95	30.67	30.67	32.34	32.34	37.50
Plasma Concentration of Aldosterone (ng/ml)	control	—	10.4	12.2	6.3	7.0	5.4	11.3
	heat	10.0	—	4.8	5.7	10.0	4.4	3.8
Urinary Concentration of Sodium (mEq/L)	control	3.0	4.0	4.0	4.0	4.0	7.0	3.0
	heat	1.0	12.5	8.0	5.0	7.5	7.5	7.5
Urinary Concentration of Potassium (mEq/L)	control	256.0	262.0	240.0	208.0	124.0	182.0	181.0
	heat	266.0	405.0	286.0	395.0	410.0	392.5	417.5
Urinary Concentration of Chloride (mEq/L)	control	121.0	143.0	119.0	147.0	61.0	109.0	70.0
	heat	258.0	133.0	173.0	176.0	210.0	242.0	211.0
Urinary Concentration of Creatinine (pg/ml)	control	706.3	531.3	787.5	750.5	537.5	752.5	1,190.0
	heat	768.8	828.1	837.5	1,168.8	1,250.0	1,137.5	1,406.3
Urinary Creatinine/Plasma Creatinine	control	39.64	37.76	57.95	55.19	39.55	55.37	79.33
	heat	24.12	26.76	27.49	38.37	38.65	35.17	37.50
Fractional Excretion of Sodium (%)	control	0.061	0.082	0.053	0.056	0.078	0.101	0.029
	heat	0.033	0.374	0.229	0.102	0.155	0.173	0.016
Fractional Excretion of Potassium (%)	control	146.77	161.36	103.54	94.22	76.46	82.17	58.5
	heat	256.47	388.08	273.77	263.96	272.01	293.69	292.99
Fractional Excretion of Chloride (%)	control	3.28	4.26	2.21	2.86	1.67	2.15	1.01
	heat	11.61	5.42	6.44	4.53	5.85	7.56	6.05

Table 20 Concentration of Evan's blue and count of tritiated water after correction of buffalo No 6 under control and heat stress periods.

time	concentration of Evan's blue (mg/ml)		count of tritiated water after correction (cpm)			
			control		heat	
	control	heat	Xc	Xc-control	Xc	Xc-control
30 min } control plasma volume		5.76				
40 min		6.26				
50 min		6.13				
60 min		5.53				
0 (control TOH)			930.70	0	551.13	0
20 min	5.21		5,113.22	4,182.52	7,454.95	6,903.82
40 min	5.49		9,004.61	8,073.91	7,470.52	6,919.39
50 min	5.60		–	–	–	–
60 min	4.93		8,288.03	7,357.33	8,410.46	7,859.33
2 hours			7,462.57	6,531.87	8,849.86	8,298.73
3 hours			9,334.57	8,403.87	8,700.06	8,148.93
4 hours			7,845.65	6,914.95	10,161.48	9,610.35
4.30 hours		5.83	–	–	–	–
4.40 hours		5.55	–	–	–	–
4.50 hours		5.34	–	–	–	–
5 hours		5.11	8,490.48	7,559.78	6,551.24	6,000.11
6 hours			6,102.29	5,171.59	6,738.99	6,187.86
20 hours			4,744.05	3,813.35	5,813.94	5,262.81
30 hours			5,134.39	4,203.69	5,209.59	4,658.46
44 hours			4,821.97	3,891.27	5,192.06	4,640.93
54 hours			3,639.75	2,709.15	3,933.70	3,382.57

BIOGRAPHY

Miss Kalaya Youngsukying was born on July, 1, 1960 in Bangkok. She received her high school certificate from Triamudom Suksa school, Bangkok in 1978 and her B.Sc. in Radiological Technology from Mahidol University, Bangkok in 1983.