CAN FOALING BE PREDICTED WITHIN 24-HOURS BY TESTING THE PH OF THE MARE'S MILK?

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Background

Mare gestation ranges from 320-362 days; however, most mares will foal within 330-345 days (The Horse, 2015). This wide range of days available for parturition makes gestation length an unreliable method to predict parturition (Canisso et al., 2013). The signs that show mares' are close to reaching parturition are: development of the mammary gland, 2-6 weeks prior to parturition; relaxation of the croup muscles, 7-19 days prior to parturition; teats distend with colostrum, 4-6 days prior to parturition; and waxing or dripping from teats, 2-4 days and 24-48 hours, respectively, prior to parturition (Wright and Kenney, 2000). Being able to closely predict the timing of parturition will allow horse producers to be more available to supervise and assist, if necessary, with foaling.

Korosue et al. (2013) performed research to determine if the pH and calcium carbonate levels of milk from preparturient mares changed as time to parturition decreased by measuring the mammary gland secretions twice a day. This study was the first to make this comparison and found that as time to parturition decreased, the pH of the milk decreased from 7.6 to 6.6 while the calcium carbonate content of the milk increased from 100µg/g to 500µg/g (Korosue et al., 2013). The study done by Canisso et al. (2013) determined if the results from the Korosue et al. study could be duplicated while measuring only once a day. The results of this study showed that the pH of the milk began decreasing four days prior to parturition and then significantly decreased on the day of parturition.

Therefore, the objective of our study was to determine if these results could be repeated in a much smaller, practical situation. The pH, calcium carbonate, total alkalinity, static ORP and capacity of the mammary gland secretion was tests daily on a single mare.

Methods

Mammary gland secretion sampling – Mammary gland secretions were taken starting at day 337 of gestation (day 11) in order to establish a base measurement to compare results to and ending the day of parturition (day 0). Each day 10-15mL of milk was collected in a tube between 12 and 3pm (Figure 8).

pH test methods – The pH of the mammary gland secretions were analyzed with a pH meter and a pH test strip. The pH meter was calibrated daily using a pH buffer solution of pH 4.0. The pH of the mammary gland secretion sample was then measured by completely immersing the electrode in the sample. Between measurements the electrode was thoroughly rinsed with deionized water. The measurement of pH with the test strip was performed after the pH meter. The test strip was submerged in the tube for about 1-2 seconds then placed beside the container to compare with the colorimetric scoring system (Figure 7).

Calcium carbonate and total alkalinity test methods – The total hardness (calcium carbonate) and total alkalinity of the mammary gland secretion sample was measured by the same test strips that contained the pH. These levels were also determined by comparing with the colorimetric scoring system on the test system container.

Redox test methods – A RedoxSYS machine was used to measure the static oxidation reduction potential (ORP) – a measure of the tendency of a chemical species to acquire electrons – and capacity of the mammary gland secretion sample. Tests were performed by inserting a RedoxSYS Sensor into the redox machine, placing 20µL of mammary gland secretion on the test strip. Once the test is complete, the machine reports the levels of Static ORP and Capacity – the ability to respond to illness or injury – of the sample. Samples were measured in

duplicate on each sample, except on samples whose measuring was too varied; then a third test was performed. All results were recorded (Table 1) and evaluated once the project was completed. The significance of measuring static ORP and capacity was to determine if levels fluctuated as parturition approached.

Foal blood sampling – IgG tests were performed on the foal 24-hours after the foal was born. This was to determine if plasma transfusion was necessary. The IgG test was performed by diluting the foal's blood, applying one drop to the sample spot, pouring the conjugate into the opening, "snapping" the test and waiting seven minutes to receive the results. The IgG test measured the foal's immunoglobulin (antibody) levels to determine level of immunity passed through the mare's colostrum (Figure 10).

Results

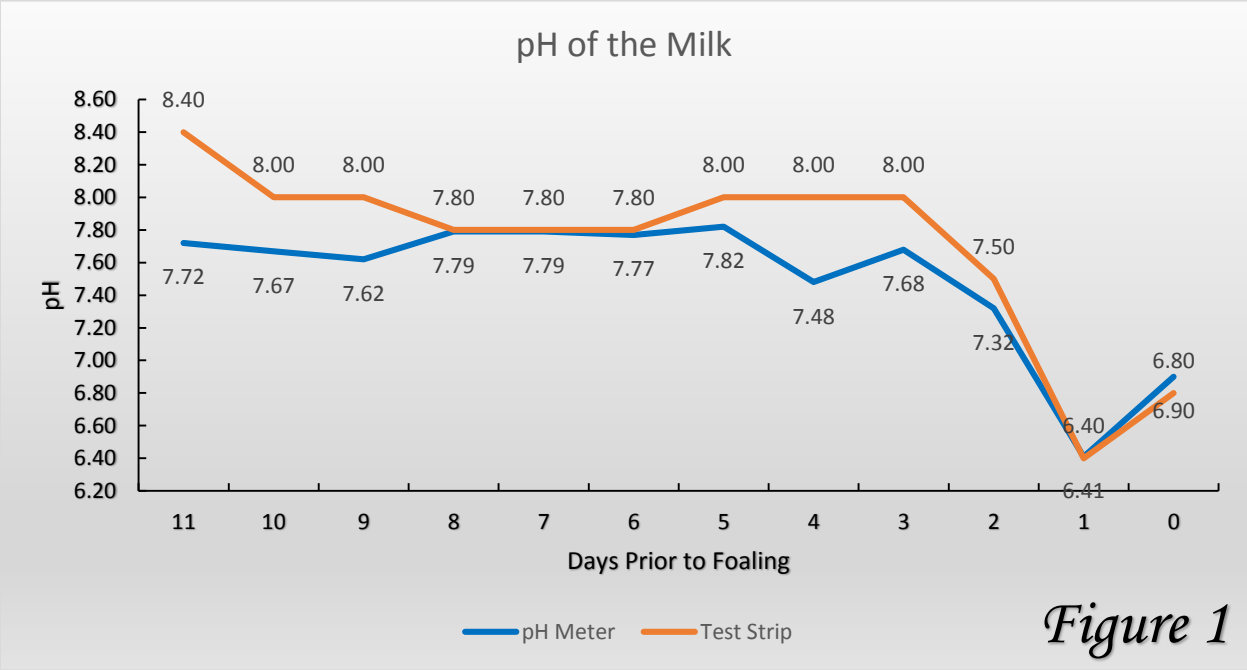

Figure 1

Figure 1 pH of the milk as time progressed from day 11 to parturition, measured by a pH meter and a test strip. The pH varied slightly until day 1 where it dropped dramatically. There was some variation in accuracy between the test strip and the pH meter, but both measured the drop.

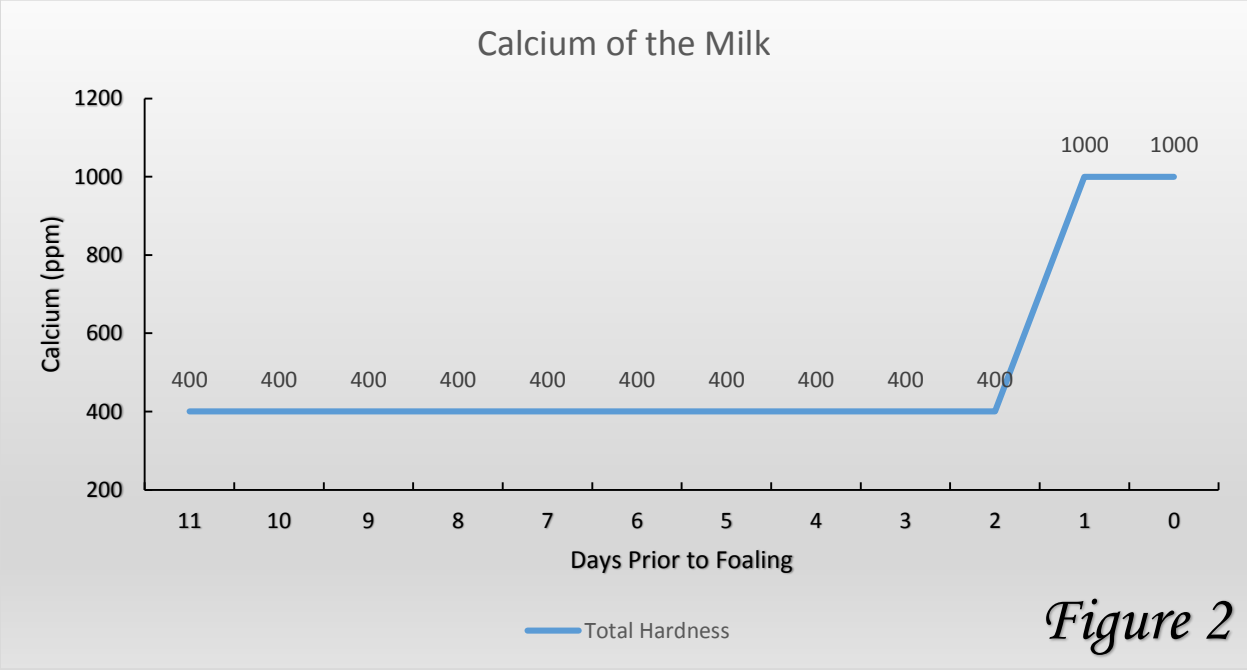

Figure 2

Figure 2 Level of calcium in the milk as time progressed from day 11 to parturition, measured by a test strip. The calcium level remained the same until day 2 where it rose dramatically.

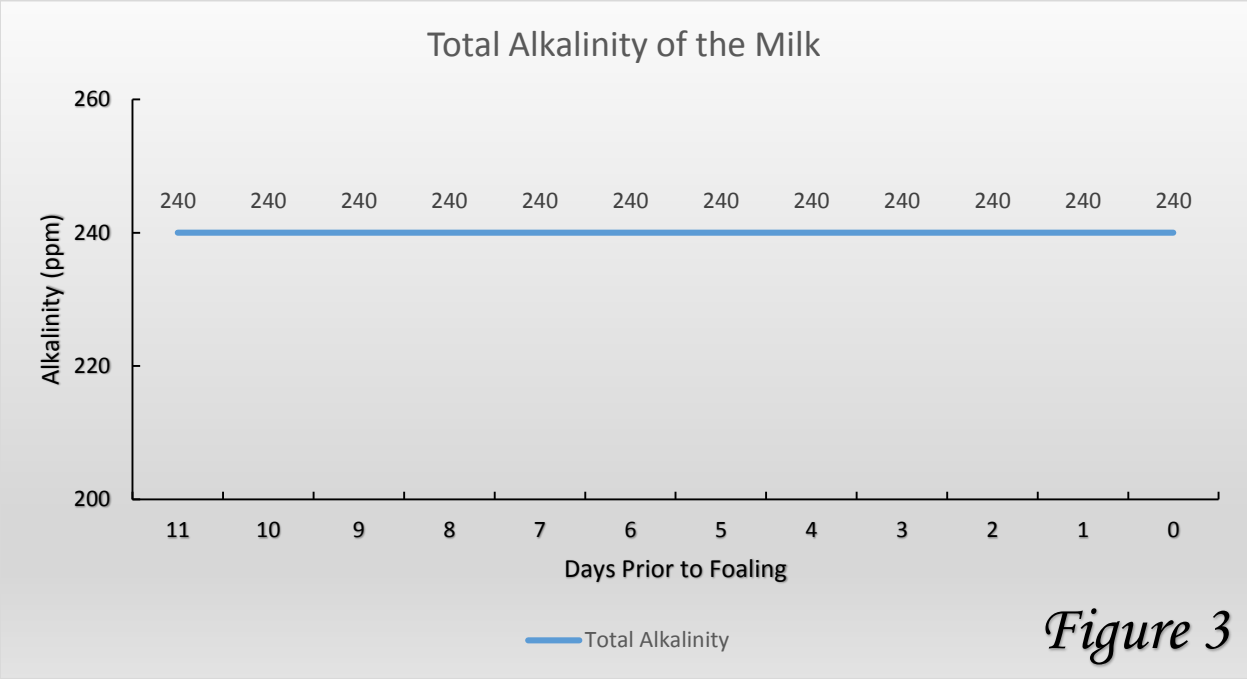

Figure 3 Total alkalinity of the milk as time progressed from day 11 to parturition, measured by a test strip. The alkalinity of the milk remained the same throughout the testing period.

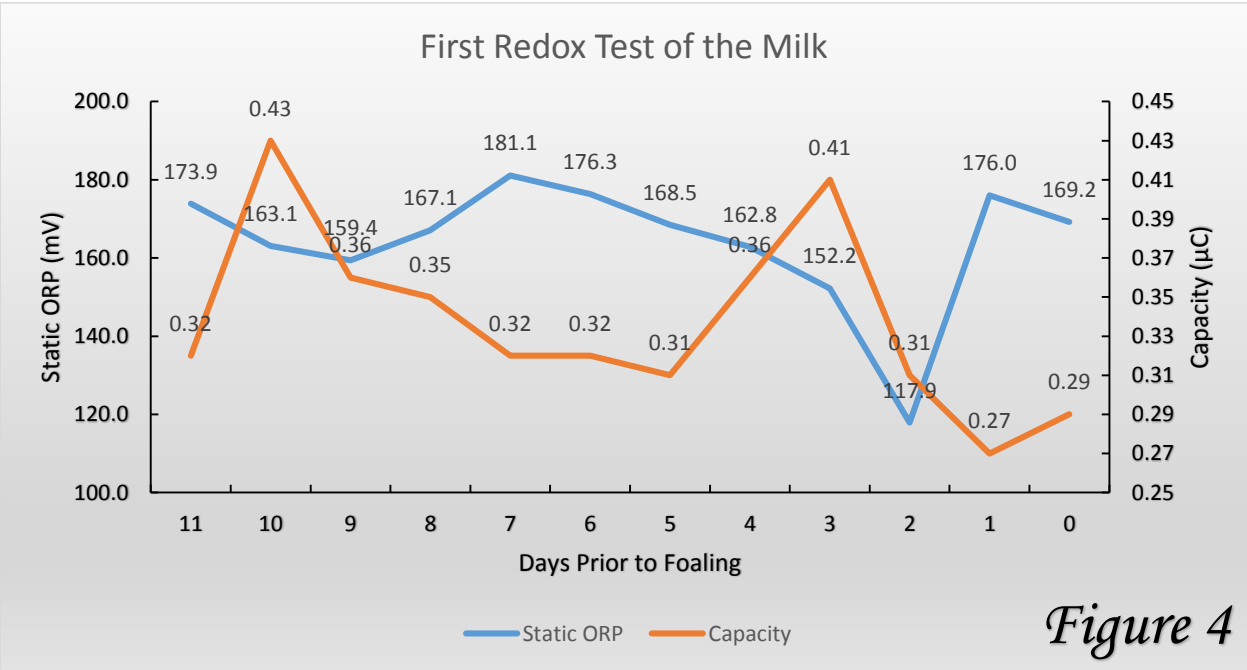

Figure 4 Levels of the static ORP and capacity levels as time progressed from day 11 to parturition, measured by a redox test. The static ORP varied slightly until day 2 where it dropped dramatically and was followed by a huge increase the next day. The capacity varied some throughout, but a dramatic drop was measured at day 3.

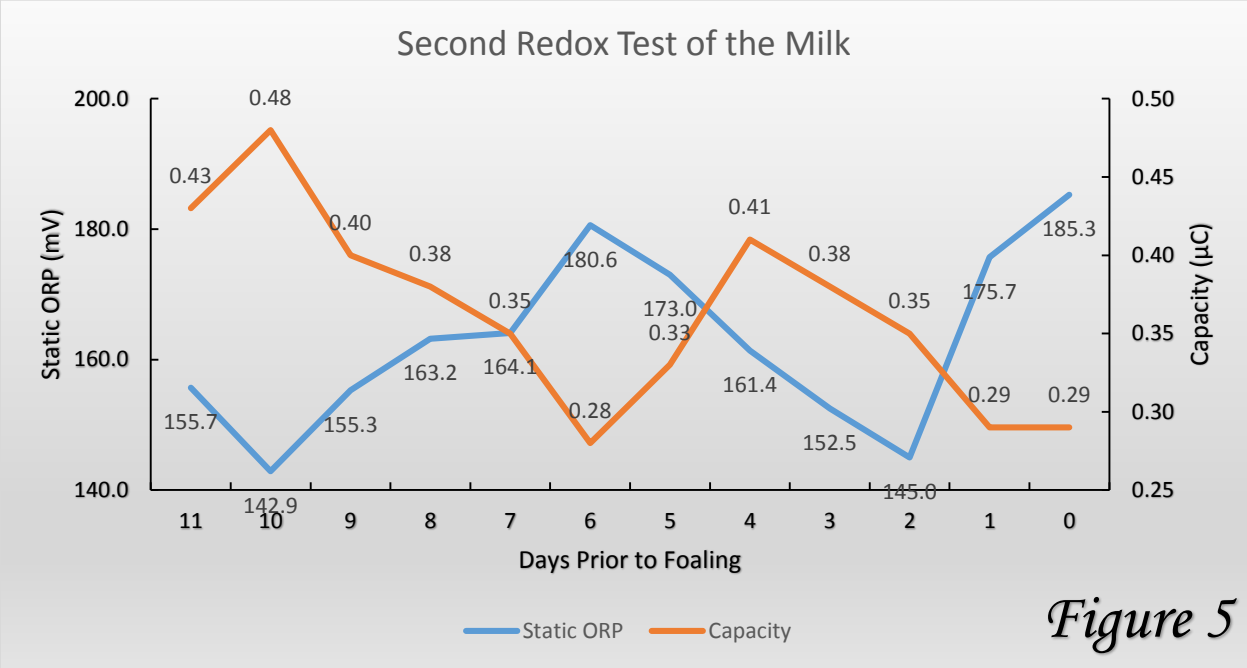

Figure 5 Levels of the static ORP and capacity levels as time progressed from day 11 to parturition, measured by a second redox test. The static ORP varied with peaks and valleys at days 10, 6, 2 and 0. The capacity varied with peaks and valleys at days 10, 6 and 4.

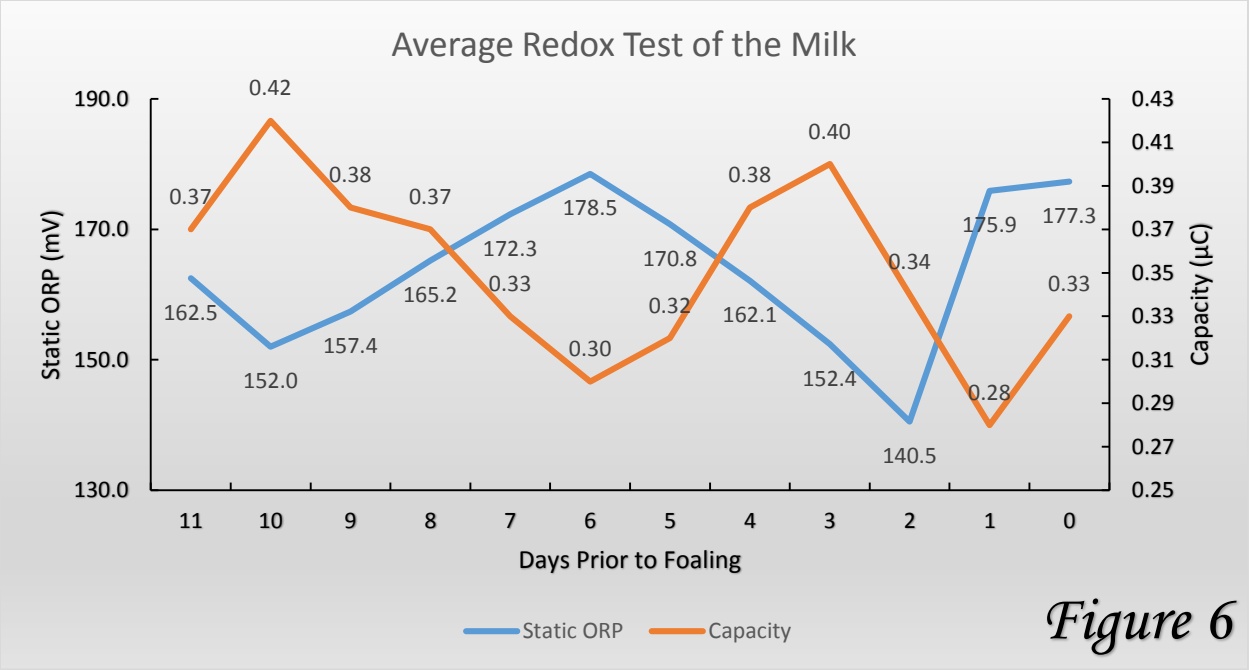

Figure 6

Figure 6 Averages in the three redox tests done. There are drops in the static ORP and peaks in the capacity on days 10, 6, 3, 2 and 1.

Figure 7 shows the change in test strips as time progressed.

Figure 8 shows a milk collection.

Figure 9 shows the redox test machine.

Figure 10 shows the completed IgG test measuring the foal's immunoglobins at 800mg/dl. Levels of 800mg/dl are normal while levels of 400mg/dl – 800mg/dl need to be monitored and tested again. Levels below 400mg/dl need a plasma transfusion in order to increase their antibodies, preventing death to the foal.

Table 1 shows the daily readings of each test.

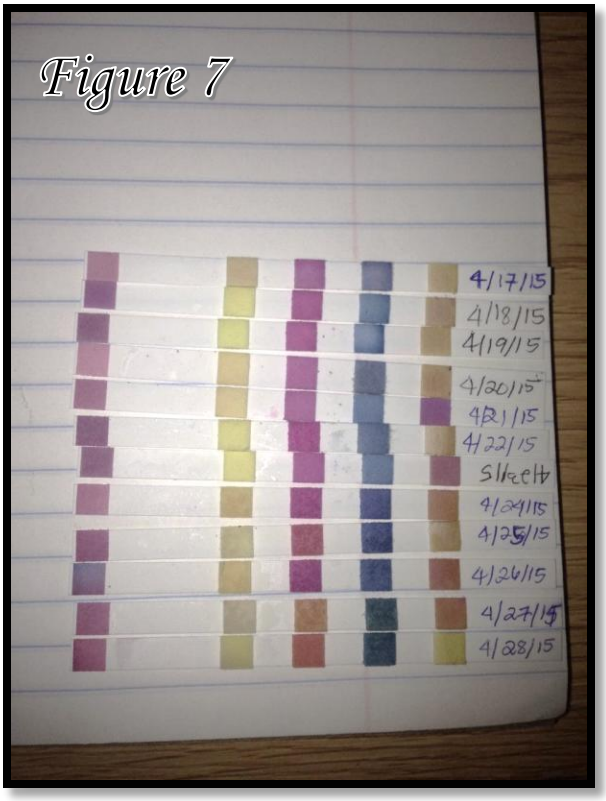

Figure 7

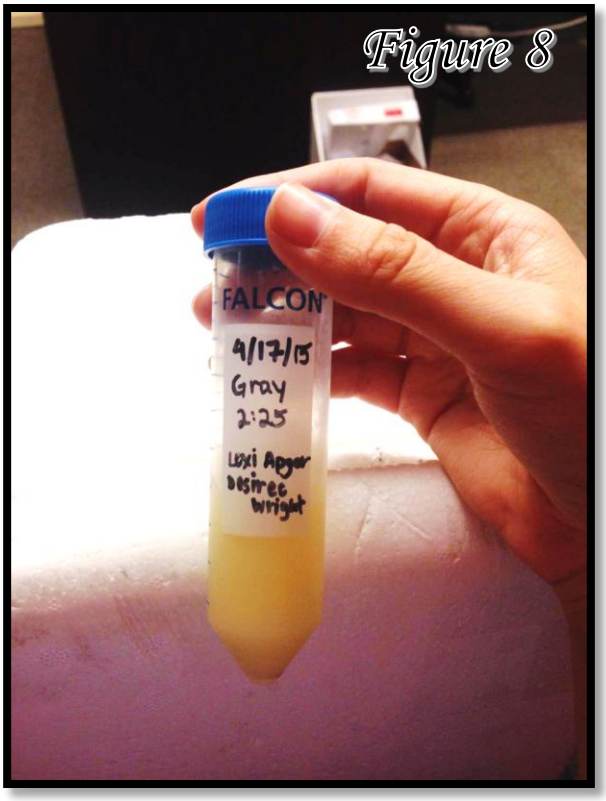

Figure 8

Figure 9

Figure 10

Table 1

Date/ Day of Gestation (Days prior to foaling)	Time Sample Collected	Time Sample Tested	pH value (pH meter)	pH value (test strip)	Total Hardness (ppm)	Total Alkalinity (ppm)	Redox Test 1 [Static ORP (mV)/ Capacity (µC)]		Redox Test 2		Redox Test 3		Redox ORP/ Capacity Averages
									ORP	Cap.	ORP	Cap.	
4/17/15 337 (11)	2:25 pm	2:56 pm	7.72	8.4	400	240	173.9 @2:56	0.32	155.7 @3:08	0.43	157.8 @3:20	0.36	162.5 0.37
4/18/15 338 (10)	1:30 pm	2:10 pm	7.76	8.0	400	240	163.1 @2:13	0.43	142.9 @2:18	0.48	150.1 @2:32	0.35	152.0 0.42
4/19/15 339 (9)	12:40 pm	1:00 pm	7.62	8.0	400	240	159.4 @1:05	0.36	155.3 @1:11	0.40			157.4 0.38
4/20/15 340 (8)	1:40 pm	3:15 pm	7.79	7.8	400	240	167.1 @3:15	0.35	163.2 @3:22	0.38			165.2 0.37
4/21/15 341 (7)	12:30 pm	1:07 pm	7.79	7.8	400	240	181.1 @1:14	0.32	164.1 @1:22	035	171.8 @1:32	0.33	172.3 0.33
4/22/15 342 (6)	1:35 pm	2:00 pm	7.77	7.8	400	240	176.3 @2:06	0.32	180.6 @2:16	0.28			178.5 0.30
4/23/15 343 (5)	1:45 pm	2:05 pm	7.82	8.0	400	240	168.5 @2:10	0.31	173.0 @2:17	0.33			170.8 0.32
4/24/15 344 (4)	1:40 pm	1:50 pm	7.48	8.0	400	240	162.8 @1:55	0.36	161.4 @2:01	0.41			162.1 0.38
4/25/15 345 (3)	1:20 pm	1:40 pm	7.68	8.0	400	240	152.2 @1:50	0.41	152.5 @1:55	0.38			152.4 0.40
4/26/15 346 (2)	12:15 pm	2:00 pm	7.32	7.5	400	240	117.9 @2:03	0.31	145.0 @2:11	0.35	158.8 @2:18	0.36	140.5 0.34
4/27/15 347 (1)	2:45 pm	3:15 pm	6.41	6.4	1000	240	176.0 @3:24	0.27	175.7 @3:31	0.29			175.9 0.28
4/28/15 348 (0)	1:00 pm	1:12 pm	6.90	6.8	1000	240	169.2 @1:23	0.35	185.3 @1:28	0.29	177.5 @1:34	0.36	177.3 0.33

Notes: Water broke @ 11:15 am, Birth @ 11:20 am, Filly on ground at 11:33 am, Stood @ 12:01 pm, Passed the placenta @ 12:12 pm,
IgG Test @ 3:50 pm on 4/29/15 (800).

Discussion

Based on the results, the hypothesis that a drop in pH will signal a 24-hour warning period before birth is supported. A drop in pH was measured on day 1 at 3:15 p.m. followed by the birth of the foal at 11:20 a.m. on day 0. Other drops or changes in readings are as follows: an increase in calcium 24 to 48 hours before birth, an increase in static ORP at 48-hours prior followed by a decrease 24-hours prior to birth, and a decrease in capacity 24 to 48 hours before birth. There was no change in total alkalinity in the milk and therefore is not an indicator of birth.

While static ORP and capacity changes were noted, the two, alone, are not great indicators since there were several peaks and valleys recorded prior to the last recorded before birth. The best indicators of the 24-hour warning period would be pH and calcium since the neither one varied greatly until the drop and peak, respectively, 24-hours before foaling.

Works Cited

Canisso, I. F., B. A. Ball, M. H. Troedsson, E. S. M. Silva and G. M. Davolli. 2013. Decreasing pH of mammary gland secretions is associated with parturition and is correlated with electrolyte concentrations in prefoaling mares. Vet. Rec. 173:218.

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