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Evaluation of Chlorine Concentration and Stability, Oxidation-Reduction Potential (ORP), and pH in 2 Commercial Chlorine Based Disinfectants at Teat Dip Concentrations

A.S. Leaflet R3163

Leo Timms, Morrill Professor of Animal Science

Summary and Implications

The objective of this overall study was to evaluate the chlorine concentrations and stability, ORP, and pH of 2 commercially available chlorine based disinfectant tablets (EfferCept^R and EfferCeptSG^R) at concentrations or formulations based for teat dipping of dairy cows. The trial is still ongoing but 36 days of data are included. Initial pH values were 5.7-5.8 and similar among products. pH increased the 1st few weeks and was higher in EF compared to SG (6.6 v. 6.2), then decreased with EF still higher than SG (6.34 v. 5.98). Initial ORP values of the 1st solutions were 900 mV and increased to 980 mV the 1st few days (EF and SG). ORP levels over the 5 weeks were 950-960 mV (EF) and 970-980 mV (SG) with SG always slightly higher than EF. ORP levels of the 2nd set of EF and SG solutions were initially ~ 980 mV and increased to > 1000 mV by 3 days. Overall ORP values show high oxidizing capacity and stability over time. Chlorine concentrations of EF and SG initially were 2200-2300 and 3000-3100 ppm, respectively. Chlorine concentrations remained higher in SG v. EF over the time period. Chlorine concentration decreased over the 36 day period but were still 1650 and 1800 ppm after 36 days. Overall, the 2 chlorine disinfectant solutions showed very high ORP levels over time, and also showed very effective chlorine concentrations over time.

Introduction

Today's consumer demands that food be produced at the highest level of quality and safety. The production and processing of safe, nutritional, high quality food products starts right on the farm. As farms get larger, their need to defend against harmful micro-organisms becomes even more critical. The capability to produce safe and effective hygiene and disinfection products on site, in sufficient quantities at a low cost, is a necessity for the farming and food industries, given current economics and input costs. This also reduces liquid transportation costs as well packaging costs, including packaging disposal. Also, many disinfectants are based on concentration of germicides but measuring the oxidation-reduction potential (ORP) of oxidizing and reducing agents can also validate or substantiate disinfectant capabilities with levels > 600 mV shown to kill bacteria.

The objective of this overall study is to evaluate the chlorine concentrations and stability, ORP, and pH of 2 commercially available chlorine based disinfectant tablets (EfferCept^R and EfferCeptSG^R) at concentrations or formulations based for teat dipping of dairy cows.

Materials and Methods

Initial base products: The initial base germicidal products were EfferCept^R (EF) and EfferCeptSG^R (SG) (Effercept.com). Products were solid dry tablets that are designed to be dissolved in water to achieve proper concentrations (SG has additional cleaner and emollients).

Teat dip products: Appropriate dilutions of products based on company recommendations were made and initially tested in 2 liter hard plastic bottles on day 0. Two EfferCept tablets were added to 1893 ml (.5 gal) of water per company recommendations. One EfferCeptSG tablet was added to 1893 ml (.5 gal) of water per company recommendations. Following initial measurements on Day 0, both solutions were put into non-siphoning teat dip cups to mimic on-farm conditions and subsequent measurements were made on solutions in the teat dippers. The trial is still ongoing but the 1st 36 days of measurements are included in this report. On Day 33, a new set of EfferCept and EfferCeptSG solutions were made in the 2 l hard plastic bottles (validate initial samples) and measurements in these samples are all from solutions in the initial plastic bottles (no transfer to dippers). Water that was utilized to make products as well as used in the chlorine titration assays was also measured during the study. (Figure 1)

Product ORP and pH values: ORP (mV) and pH were measured in all solutions using a Combo pH/ORP and temperature meter (HI 98121, Hanna Instruments, Woonsocket, RI). Measurements were daily the 1st 2 days, every 2 days the 1st 2 weeks, then every 3-4 days thereafter.

Product chlorine concentrations and stability: Chlorine concentrations (ppm) in the commercial products were tested every time pH and ORP were measured from the teat dippers. Testing was done with a chloride titration testing kit and compounds (AquaPhoenix, Hanover, PA). 10 drops of a 50% Potassium iodide was added to the diluted sample followed by 3 drops of 50% sulfuric acid (yellow color indicated chlorine present). 5 drops of a 1% starch solution were then added (blue color) and then drops (1 at a time) of a thiosulfate titrant solution were added until the sample turned colorless. Initial solution was diluted 10 fold 2X (100 fold dilution), so each thiosulfate drop equated to 100 ppm total available chlorine. (Fig. 1).

Results and Discussion

All data for all measurements (39 d) is shown in Table 1.

pH measurements: pH measurements of chlorine solutions are in Figure 2. Initial EF and SG pH values were similar (5.6-5.8). pH increased to 6.4-6.6 and 6.1-6.2 in EF and SG respectively, with EF consistently higher than SG. Water pH ranged from 8.65 – 9.31.

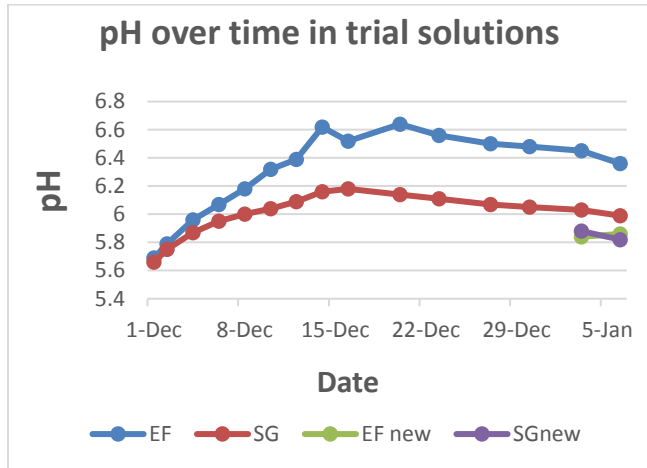


Figure 2: pH of EfferCept[®] and EfferCeptSG[®] solutions over time.

ORP: ORP measurements of chlorine solutions are in Figure 3. Initial ORP of EF and SG were ~ 900 mV and increased the 1st 2 days to ~ 980mV. EF ORP dropped over time to ~ 940 mV while SG remained at 960 – 980 mV. Initial ORP on the 2nd set of solutions was ~ 980 mV and increased to 1000+ mV by 3 days. Overall ORP mV levels in all samples over time were very high, indicating excellent oxidation - reduction potential. Water ORP measurements over time ranged from 268 – 470 mV.

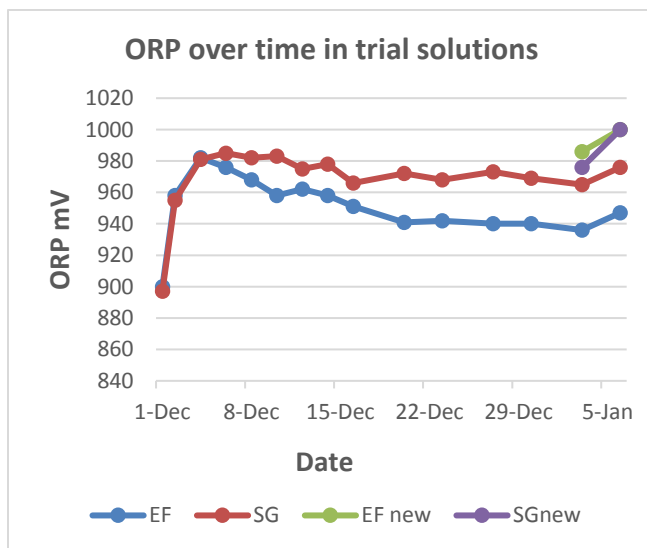


Figure 3: ORP measurements (mV) of EfferCept[®] and EfferCeptSG[®] solutions over time.

Chlorine concentrations: Chlorine concentrations over a 36 day period are shown in Figure 4. Initial chlorine concentrations of the 1st EF and SG solutions were 2200 and 3100 ppm, respectively. Initial chlorine concentrations of the 2nd new EF and SG solutions were similar (2400 and 3000 ppm). Chlorine concentrations of both EF and SG diminished over time but were still 1650 and 1800 ppm after 36 days.

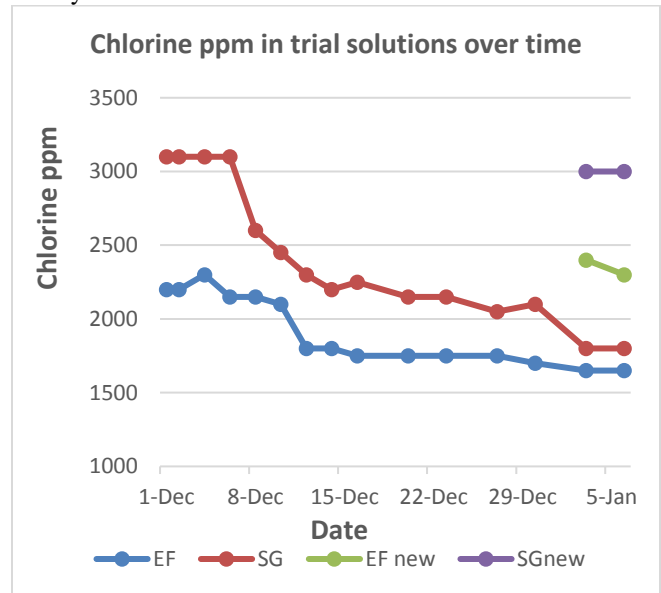


Figure 4: Chlorine concentrations of EfferCept[®] and EfferCeptSG[®] solutions over time.

Summary

The objective of this overall study was to evaluate the chlorine concentrations and stability, ORP, and pH of 2 commercially available chlorine based disinfectant tablets (EfferCept[®] and EfferCeptSG[®]) at concentrations or formulations based for teat dipping of dairy cows. The trial is still ongoing but 36 days of data are included. Initial pH values were 5.7-5.8 and similar among products. pH increased the 1st few weeks and was higher in EF compared to SG (6.6 v. 6.2), then decreased with EF still higher than SG (6.34 v. 5.98). Initial ORP values of the 1st solutions were 900 mV and increased to 980 mV the 1st few days.(EF and SG) . ORP levels over the 5 weeks were 950-960 mV (EF) and 970-980 mV (SG) with SG always slightly higher than EF. ORP levels of the 2nd set of EF and SG solutions were initially ~ 980 mV and increased to > 1000 mV by 3 days. Overall ORP values show high oxidizing capacity and stability over time. Chlorine concentrations of EF and SG initially were 2200-2300 and 3000-3100 ppm, respectively. Chlorine concentrations remained higher in SG v. EF over the time period. Chlorine concentration decreased over the 36 day period but were still 1650 and 1800 ppm after 36 days. Overall, the 2 chlorine disinfectant solutions showed very high ORP levels over time, and also showed very effective chlorine concentrations over time.



Figure 1. pH /ORP meter and chlorine titration reagents and kit for measuring pH, ORP, and chlorine concentrations over time in EfferCept^R, EfferCeptSG^R, and water. Initial solutions were made in the 2 liter hard plastic bottles, then transferred to non-siphoning teat dip cups to mimic farm dipper conditions. EF new and EFSG new were stored in plastic 2 liter bottles.

Table 1. pH, ORP, and chlorine concentration measured over time on EfferCept, EfferCeptSG and water (ph /ORP on water)

ph, ORP and chlorine measured on Effercept and Effercept SG (pH and ORP on water also)																
		<u>pH</u>					<u>ORP</u>					<u>PPM Chlorine</u>				
<u>date</u>	<u>EF</u>	<u>SG</u>	<u>H2O</u>	<u>EF new</u>	<u>SGnew</u>	<u>date</u>	<u>EF</u>	<u>SG</u>	<u>H2O</u>	<u>EF new</u>	<u>SGnew</u>	<u>date</u>	<u>EF</u>	<u>SG</u>	<u>EF new</u>	<u>SGnew</u>
1-Dec	5.69	5.66				1-Dec	900	897				1-Dec	2200	3100		
2-Dec	5.79	5.75				2-Dec	958	955				2-Dec	2200	3100		
4-Dec	5.96	5.87	8.65			4-Dec	982	981	470			4-Dec	2300	3100		
6-Dec	6.07	5.95	8.84			6-Dec	976	985	342			6-Dec	2150	3100		
8-Dec	6.18	6	8.79			8-Dec	968	982	325			8-Dec	2150	2600		
10-Dec	6.32	6.04	9			10-Dec	958	983	302			10-Dec	2100	2450		
12-Dec	6.39	6.09	8.99			12-Dec	962	975	322			12-Dec	1800	2300		
14-Dec	6.62	6.16	9.08			14-Dec	958	978	326			14-Dec	1800	2200		
16-Dec	6.52	6.18	9.15			16-Dec	951	966	346			16-Dec	1750	2250		
20-Dec	6.64	6.14	9.11			20-Dec	941	972	343			20-Dec	1750	2150		
23-Dec	6.56	6.11	9.27			23-Dec	942	968	321			23-Dec	1750	2150		
27-Dec	6.5	6.07	9.26			27-Dec	940	973	278			27-Dec	1750	2050		
30-Dec	6.48	6.05	9.28			30-Dec	940	969	290			30-Dec	1700	2100		
3-Jan	6.45	6.03	9.31	5.84	5.88	3-Jan	936	965	268	986	976	3-Jan	1650	1800	2400	3000
6-Jan	6.36	5.99	9.28	5.86	5.82	6-Jan	947	976	361	1000	1000	6-Jan	1650	1800	2300	3000
9-Jan	6.34	5.98	9.25	5.88	5.82	9-Jan	943	982	399	1000	1000	9-Jan	1650	1700	2100	2800