



A COMPARATIVE ANALYSIS OF THE BACTERICIDAL ACTIVITY OF KEM SAN® LIQUID ANTIMICROBIAL VERSUS OTHER WATER ACIDIFIERS¹

KEY CONCLUSIONS

KEM SAN® Liquid Antimicrobial:

- Had superior bactericidal activity over *Salmonella*, *E.coli*, *Pasteurella*, *Streptococcus* and *Clostridium* when compared to Product “A” and citric acid
- Effectively decreases and maintains pH at 4.5 even as concentration increases

INTRODUCTION

A wide variety of products designed to acidify the drinking water of livestock and poultry are available in the marketplace today. The generally accepted practice is to acidify the drinking water in an effort to purify the water in the process. To that end, a target pH of the drinking water is typically used to quantify the purification power of the acidifying agent.

A laboratory study was designed and carried out to measure the final pH of drinking water containing four different inclusion levels of three commonly used acidifying products. Using a selection of organisms pathogenic to livestock and poultry, the bactericidal activity of each acidifier product was also tabulated at the different concentrations.

MATERIALS AND METHODS

Acidifying products tested were KEM SAN liquid antimicrobial, citric acid, and a competitive product (Product “A”) frequently used in the industry. KEM SAN liquid antimicrobial and Product “A,” both in liquid form, were added directly to the water. Citric acid, a dry product, was mixed into a stock solution containing 410 g of citric acid in one gallon of water, which was then added to the drinking water. Concentrations of each acidifier product were set at 0, 0.25, 0.5, 1.0, and 2.0 oz/gal of water. The resulting pH of the water was then measured.

Selected pathogenic bacteria were added to a portion of each water sample at the rates of 100,000, 10,000, 1,000, 100, and 10 colony-forming units (cfu) per ml. After a 24-hour incubation period, a positive or negative turbidity reading was taken on each inoculated water sample. If the water sample was cloudy, the reading was positive, indicating bacterial growth. If the water sample was clear, the reading was negative, indicating bacterial growth did not occur.

RESULTS AND DISCUSSION

The pH of all untreated water was 6.9, while the pH of all treated water was significantly lower. It is interesting to note that the water pH following addition of citric acid or Product “A” was very similar at all treatment concentrations; whereas, the pH of the water treated with KEM SAN liquid antimicrobial dropped to 4.5 and did not go lower as the concentration increased. This intended response is advantageous for handling characteristics and equipment life. Bacterial viability was confirmed for each organism at each level of inoculation by generating a positive turbidity reading. The bactericidal activity of each acidifying product is notably different.

In this study, the relative bactericidal activity of KEM SAN liquid antimicrobial was superior to Product “A”, which was superior to citric acid. See the following charts for specific results. Note that a “+” sign indicates bacterial activity while a “-” sign indicates no bacterial activity. Also note that a larger shaded area in the charts indicates a higher level of biocidal activity.

<i>Salmonella choleraesuis</i> (Hog isolate)						
Treatment	oz/gal	Inoculum Rate (cfu/ml)				
		10 ⁶	10 ⁴	10 ³	10 ²	10 ¹
Control		+	+	+	+	+
KEM SAN	0.25	+	+	+	+	+
	0.50	-	-	-	-	-
	1.00	-	-	-	-	-
	2.00	-	-	-	-	-
Citric Acid	0.25	+	+	+	+	+
	0.50	+	+	+	+	+
	1.00	+	+	+	+	+
	2.00	+	+	+	+	+
Product A	0.25	+	+	+	+	+
	0.50	+	+	+	+	+
	1.00	-	-	-	-	-
	2.00	-	-	-	-	-

<i>Salmonella typhimurium</i> (ATCC 14028)						
Treatment	oz/gal	Inoculum Rate (cfu/ml)				
		10 ⁶	10 ⁴	10 ³	10 ²	10 ¹
Control		+	+	+	+	+
KEM SAN	0.25	+	+	+	+	+
	0.50	-	-	-	-	-
	1.00	-	-	-	-	-
	2.00	-	-	-	-	-
Citric Acid	0.25	+	+	+	+	+
	0.50	+	+	+	+	+
	1.00	+	+	+	+	+
	2.00	+	+	+	+	+
Product A	0.25	+	+	+	+	+
	0.50	+	+	+	+	+
	1.00	-	-	-	-	-
	2.00	-	-	-	-	-

<i>Pasteurella multocida</i> (ATCC 15743)						
Treatment	oz/gal	Inoculum Rate (cfu/ml)				
		10 ⁶	10 ⁴	10 ³	10 ²	10 ¹
Control		+	+	+	+	+
KEM SAN	0.25	+	+	+	+	+
	0.50	-	-	-	-	-
	1.00	-	-	-	-	-
	2.00	-	-	-	-	-
Citric Acid	0.25	+	+	+	+	+
	0.50	+	+	+	+	+
	1.00	+	+	+	+	+
	2.00	+	+	+	+	+
Product A	0.25	+	+	+	+	+
	0.50	+	+	+	+	+
	1.00	-	-	-	-	-
	2.00	-	-	-	-	-

<i>E. coli</i> (Turkey isolate)						
Treatment	oz/gal	Inoculum Rate (cfu/ml)				
		10 ⁶	10 ⁴	10 ³	10 ²	10 ¹
Control		+	+	+	+	+
KEM SAN	0.25	+	+	+	+	+
	0.50	-	-	-	-	-
	1.00	-	-	-	-	-
	2.00	-	-	-	-	-
Citric Acid	0.25	+	+	+	+	+
	0.50	+	+	+	+	+
	1.00	+	+	+	+	+
	2.00	+	+	+	+	+
Product A	0.25	+	+	+	+	+
	0.50	+	+	+	+	+
	1.00	+	+	+	+	+
	2.00	-	-	-	-	-

<i>Clostridium perfringens</i> (ATCC 3626)						
Treatment	oz/gal	Inoculum Rate (cfu/ml)				
		10 ⁶	10 ⁴	10 ³	10 ²	10 ¹
Control		+	+	+	+	+
KEM SAN	0.25	+	+	+	+	+
	0.50	-	-	-	-	-
	1.00	-	-	-	-	-
	2.00	-	-	-	-	-
Citric Acid	0.25	+	+	+	+	+
	0.50	+	+	+	+	+
	1.00	+	+	+	+	+
	2.00	+	+	+	+	+
Product A	0.25	+	+	+	+	+
	0.50	+	+	+	+	+
	1.00	-	-	-	-	-
	2.00	-	-	-	-	-

<i>Streptococcus suis</i> (ATCC 43765)						
Treatment	oz/gal	Inoculum Rate (cfu/ml)				
		10 ⁶	10 ⁴	10 ³	10 ²	10 ¹
Control		+	+	+	+	+
KEM SAN	0.25	+	+	+	+	+
	0.50	+	+	+	+	+
	1.00	-	-	-	-	-
	2.00	-	-	-	-	-
Citric Acid	0.25	+	+	+	+	+
	0.50	+	+	+	+	+
	1.00	+	+	+	+	+
	2.00	+	+	+	+	+
Product A	0.25	+	+	+	+	+
	0.50	+	+	+	+	+
	1.00	-	-	-	-	-
	2.00	-	-	-	-	-

CONCLUSIONS

This study clearly demonstrates that the bactericidal characteristics of a particular water acidifier product cannot be judged solely by its ability to lower the pH (i.e. acidify) of the water. Likewise, the bactericidal activity of a given acidifier may vary widely depending upon the organism tested. Finally, this study demonstrates the consistent superior bactericidal strength of KEM SAN liquid antimicrobial against *E. coli*, *Pasteurella*, *Salmonella*, *Streptococcus* and *Clostridium* when compared to Product "A" and citric acid.

References:

1. A Comparison of Water Acidifiers on Drinking Water pH and Bactericidal Properties, BB-03-00220.