RESIDUE AND pH EFFECTS ON THERAPEUTIC PRODUCTS ADMINISTERED THROUGH THE WATER

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In today’s large swine production systems, mass treatment situations often call for the use of approved therapeutic agents to be administered through the waterlines. These agents include antimicrobials (antibiotics and synthetics), aspirins, and vitamins. An epidemiological study recently published investigated the prevalence of problems associated with swine production drinking systems in North America, Europe, Southeast Asia, and Africa. (Carr. J., 2002) Analysis was done on water quality (contamination), number of drinkers, drinker height, water flow, drinker position, and time spent drinking. This study identified approximately 60 different point-source problems with water administration in these swine production systems, including antibiotic residues in the water lines. Furthermore, recent fieldwork has indicated great variability in water pH among farms within the same production system, and even in farms that are in close proximity to each other.

Bottom line, there are many problems associated with mass treating pigs by administering therapeutic agents through the waterlines. There is great variability in the flow rates due to clogged lines (residues from other treatments, sludge) and water pressure. Baseline water palatability is also an important issue. Also, what happens to the palatability when therapeutic agents are added? Furthermore, there is variation among medicators due to sludge, residues, stock solution solubility, and sediment formation. (Fig. 1) In addition, the healthy pigs, which fit nicely into the water consumption curve, may be receiving their correct dose per day, but what dose are the clinically ill pigs receiving? These problems with waterline administration therapeutic agents will all potentially lead to sub-therapeutic dosing.

So, what are some potential harmful sequelae that may arise from sub-therapeutic dosing? First, there is no help being provided to the pigs. Second, sub-therapeutic dosing may make subsequent treatment modalities more difficult or ineffective through selection of sub-populations of resistant bacteria. This will possibly make conventional treatment options ineffective which will result in increased or extended morbidity and mortality, increased treatment time, and increase treatment cost.

In field situations it is often difficult to troubleshoot treatment failure due to waterline problems and sub-therapeutic dosing when using water-soluble products because of the many different variables involved in the treatment process. However, producers / service people typically have some common complaints:

1. The pigs will not drink the medicated water.
2. The pharmaceutical settles out in stock solution.
3. The pharmaceutical will not go into solution at the recommended dose.
4. The stock solution will not run efficiently through the medicator or waterlines.

Very important and often overlooked problems include the solubility and reaction potentials of therapeutic products when exposed to water over a range of pH’s. Also, the use of, and potential reactivity with commonly used pH modifiers. Antibiotic residues in the waterlines are also potential factors that may contribute to treatment failure when administering water-soluble products due to reactions that may occur between different therapeutic products.

Figure 1. Antimicrobial precipitation in the bottom of a stock solution container resulting in a clogged medicator input line.

For example, in a previous study, the following common water-soluble therapeutic agents were evaluated for their reactivity with each other to simulate waterline residue reactions:

- Sodium Salicylate
- Acetylsalicylic Acid
- Amoxicillin
- Sulfamethoxazole / Trimethoprim
- Potassium Penicillin G
- Gentamycin
- Lincomycin
- Neomycin – 2 types
- Tetracycline
- Oxytetracycline
- Chlortetracycline
- Chlortetracycline / Sulfamethazine
- Sulfamethazine
- Tiamulin
• Tylosin
• Vitamin Supplement

All compounds were evaluated and mixed based on manufacturer package recommendations for therapeutic dosing through a medicator set at a ratio of 1:128. Baseline pH’s, temperatures, and any changes in these values post mixing were measured in the stock solution using a pH meter (Denver Instruments). All products were mixed using water at a range of pH’s noting any deviation in appearance or solubility. Products commonly used to alter pH (citric acid, ammonia) were also used in this evaluation, and tested for pH, temperature change, and physical appearance when they were added to the therapeutic agents. All therapeutic products were evaluated for any change in appearance or baseline temperature when exposed to other therapeutic products to simulate waterline or medicator residue reactions.

Overall, the range in stock solution pH was very wide (3.1 to 10.5). Figure 2. The percent reactivity (ie. A test product precipitated out of solution when exposed to another test solution) ranged from 0% to 53%. Although the most acidic and basic substances accounted for a majority of the reactions, precipitation occurred throughout the whole range of pH’s. When the products were exposed to pH modifiers (citric acid and ammonia) a number of reactions occurred. Acetylsalicylic acid, amoxicillin, SMZ-TMP,

![Figure 2. Therapeutic product pH range and percent reactivity with other compounds. The bars in the foreground represent the pH of the compound (left vertical axis) and the background represents the respective compounds percent reactivity with the other substances (right vertical axis) (ex. Chlortetracycline-Sulpha had a stock solution pH of 3.1 and reacted with 35% of the other test products in solution.) Aspirin P = powdered aspirin (acetylsalicylic acid) – Aspirin L = liquid aspirin (sodium salicylate)
potassium penicillin G, and sulphamethazine all reacted with citric acid. Tetracycline, oxytetracycline, chloretetracycline-sulpha, and tiamulin all reacted with ammonia.

These results stress the importance of maintaining clean waterlines, medicators, and stock solution buckets. If waterlines are flushed with a substance such as chlorine, hydrogen peroxide, or sodium thiosulfate for purposes of cleaning or chelating, a fresh water flush should be completed before any water soluble therapeutic product is administered. Also, water quality and pH need to be checked because these factors will also have an impact on the effectiveness and efficiency of therapeutics when administered through the water.