

Alternative Compounds for Preserving Milk

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One system of feeding milk to dairy calves is a free-access group feeding approach. One of the key factors to success in this system is identifying chemicals and/or treatments that can be used to control spoilage by controlling or decreasing bacterial growth. Milk is an ideal medium containing nutrients that readily support bacterial growth. There have been a number of approaches used to control bacterial growth in milk. One approach has been to add chemicals to decrease bacterial growth. In most situations, these will lower milk pH to about 4 - 4.5 or so which limits the growth of many bacteria in milk. There has been extensive research in this area going back at least 60 years. A key consideration is that the chemical added to the milk must meet FDA guidelines for use in animal feeds. A number of the chemicals that have been used are **not approved** for this use by FDA. These include formic acid, formaldehyde and hydrogen peroxide. Even though they are effective in decreasing bacterial growth, they cannot be used for this purpose in the U.S. This paper will provide an overview of other options that can be used.

1. **Acids** – There are a number of acids that have been used in research that can be used for this purpose. These include acetic, adipic, ascorbic, benzoic, citric, hydrochloric, lactic, sorbic and propionic. There is a FDA limitation that benzoic acid cannot be added at levels exceeding 0.1%. Even though there has been some research on all of these acids, citric and propionic may be the best choices at this time.
 - a. **Citric acid** – This acid has been used by a number of milk replacer companies to acidify milk replacers. However, it is difficult to determine the level of citric acid used. A recent study in Canada (Canning et.al. 2009) added citric acid to whole milk at the rate of 5.8 g per liter of milk. Even though pH of the milk was lowered to about 4.3, this study did not quantify the effects on bacterial growth.
 - b. **Propionic acid** – A large amount of work has been done using various levels of propionic acid. Even though there has been some variation in results, it appears that a level of 1% added propionic acid will usually lower pH to 4.1 to 4.8. There are some commercial propionic acid products sold in the agricultural marketplace that could potentially be used. There has also been some use of ammonium propionate since it less corrosive.
2. **Chemical Preservatives** – There are a number of chemical preservatives that are routinely used in the food industry to extend shelf life or retard spoilage. These include calcium propionate, sodium metabisulfite, sodium acetate, sodium benzoate, calcium ascorbate, calcium sorbate, potassium metabisulfite, potassium sorbate, sodium ascorbate, sodium metabisulfite, sodium propionate, sodium propionate and sorbitol.

Only a few of these have been tested as preservatives in milk in terms of either lowering pH or changes in bacterial activity.

3. **Commercial Products** – There are some commercial companies that have products available to acidify feeds. I am aware of 2 companies in the U.S. that are currently doing some testing of products in milk. These are Kemin Industries and Royal Milc. Both companies are doing some studies feeding treated milk to calves. These products are usually a mixture of both acids and some of the chemical preservatives. These may be options to use in the future once they refine their formulas. I am also exploring options that other companies may have available.
4. **Summary** – At this time, it appears that either citric or propionic acids may be the best choices to replace formic acid in acidifying milk. Both of these acids have research data indicating their ability to lower pH when added to milk. Propionic acid is a liquid while citric acid is a dry material. Since both are acids, precautions need to be taken when working with them This would include wearing gloves, goggles and having a water supply available to wash any acid from the skin. The suggested rates of these are:

- **Citric acid** = 22 grams/gallon (about 3.5 teaspoons)
- **Propionic acid** = 35-40 ml/gallon (about 1.3 ounces)

Note: The propionic acid calculation is based on a product containing 99% acid. These calculations will need to be adjusted if the acid concentration is different.

It is important to check the pH of the milk after mixing. The target is a pH o 4 to 4.5. Some research has indicated that milk consumption by calves may be reduced if milk pH is < 4.