

4/18/11

Preservatives and Acidifying Chemicals for Milk

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Background:

There is renewed interest in group feeding and free-access feeding of dairy calves with milk or waste milk on dairy farms. The recent interest in this area was stimulated by information and observations obtained from dairy farms in Finland using this approach. Neil Anderson from the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) has spearheaded the use and adoption of this approach in North America. Some of the benefits reported for this approach include lower daily labor, lower cost equipment and better use of excess colostrum, transition cow milk and other milk that can't be put in the bulk tank. It is also indicated that calves have higher daily gains than conventional feeding systems using milk replacers. There are a couple of publications from OMAFRA that provide more background and detail on this approach. These are available at:

www.omafra.gov.on.ca/english/livestock/dairy/facts/grouphousing.htm

One of the key components of this system is a way to acidify milk to preserve it and lower the growth of molds and bacteria. This increases the number of days the milk (or milk replacer) can be used without spoiling or requiring refrigeration. The goal is to lower the pH of the milk to 4 – 4.5. Lowering pH to < 4.5 inhibits or slows the growth of many of the bacteria found in milk. There are a number of chemicals that could potentially be used to lower pH of the milk. This paper will provide an overview of some of the ones that have been used or evaluated for this purpose. There was a lot of work on this topic in the U.S. in the 1970's. A review paper (Foley and Otterby, 1978) provided an excellent overview of the treatment and use of excess colostrums for dairy calves.

The approach used will be to list each chemical as a separate compound and provide some comments relative to research information, level of addition, effect on pH and regulatory status. Since the feed additive regulations vary between countries, I will only provide information from FDA (U.S. Food and Drug Administration). This will be specific to the United States. Regulatory considerations for other countries will not be covered. A summary of the various chemicals used, rates of use, pH and regulatory status are in Table 1.

Table 1. Acidifying Agents and Preservatives for Milk or Milk Replacers

Chemical	Source	Form	Use Rate	pH	FDA Status
Formic acid	Uzmay et.al., 2003	Liquid	0.23%		Not approved or permitted for addition to milk or milk replacers
"	Kaya et.al., 2003	"	0.23%	4.4 – 4.6	"
"	Muller & Shyre, 1975	"	1%	3.4 (day 4)	"
Formaldehyde	Muller & Syhre, 1975	Liquid	0.25%	5 – 5.5	Not approved or permitted for addition to milk or milk replacers
	Muller et.al., 1976	"	0.1%	4.5	"
	Rindsig and Bodoh, 1977	"	0.13	4.8	"
Hydrogen Peroxide	Saha et.al., 2003	Liquid	0.04 to 0.05%	?	Not approved or permitted for addition to milk or milk replacers
Acetic acid	Daniels et.al., 1977	Liquid	0.8%	4.34	GRAS^a
"	Polzin et.al., 1977	"	0.7%	4.78	"
Adipic acid	Foley and Otterby, 1979	Solid	1%	4.54	GRAS
Benzoic acid	Jenny et.al., 1980	Solid	0.5%	4.8	Not to exceed 0.1%

"	Muller & Smallcomb, 1977	"	0.5%		"
Citric acid	Canning et.al., 2009	Solid	0.58%	4.3	GRAS
Hydrochloric acid	Netke	Liquid	?	5	GRAS
Lactic acid	Muller	Liquid	1%	4.2	GRAS
"	Foley and Otterby, 1979	"	1%	4.3	"
Propionic acid	Rindsig et.al., 1977	Liquid	0.5%	4.9 – 5	GRAS
"	Rindsig et.al., 1977	"	1%	4.7 – 4.8	"
	Rindsig et.al., 1977	"	1.5%	4.5 – 4.6	"
	Rindsig and Bodoh, 1977	"	1%	4.3	"
	Carlson and Muller, 1977	"	1%	4.6	"
	Muller et.al., 1977	"	1%	4.1	"
	Muller	"	1%	4.5	"
	Otterby et.al., 1977	"	1.5%	4.1-4.3	"
Gluconic acid lactone	Muller & Smallcomb,	Solid	0.5%		?
Sodium acetate	Muller & Smallcomb, 1977	Solid	0.5%		GRAS
Sodium benzoate	Muller & Smallcomb,	Solid	0.5%		Not to exceed 0.1%

	1977				
"	Jenny	"	0.5%	5.1	"
Sodium formate	Muller & Smallcomb, 1977	Solid	0.5%		?
Sodium propionate	Muller & Smallcomb, 1977	Solid	0.5%		GRAS
Sorbitol	Muller & Smallcomb, 1977	Solid	0.5%		GRAS

^A GRAS = generally recognized as safe by FDA. These compounds can be used in animal feeds with no restrictions.

Disclaimer: The regulatory status in the above table is my interpretation of the current FDA regulations. This information has been derived from email interactions with FDA, looking at information in the FDA electronic CFR (Code of Federal Regulations) and information from AAFCO (Association of American Feed Control Officials). The data is my evaluation of this information and is only for guidance. The final authority on the use of these compounds in milk rests with FDA. Specific questions need to be addressed to and answered directly by FDA.

Preservatives for Milk – Reference List

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