Teat Disinfectants and Overall Teat Health

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Objectives

- Understand that teat disinfectants are designed to disinfectant the skin of the teat
- Understand what kind of mastitis causing organisms pre-milking and post-milking teat disinfectants are designed to control
- Understand that post-milking teat disinfectants have added skin conditioners to maintain and/or improve skin condition
- Understand the methods for evaluation of short- and long-term teat health



Outline

- History of teat disinfection
- Goal of teat disinfection
- What makes up a teat dip
- Methods of application
- Environmental conditions
- Teat health evaluation



History

1900's	50's	60's	70's	80's	90's	00's
Dilute pine oil as disinfectant- 1916	Research from Guelf shed light on positive impact from disinfecting teats	Udderwashes - dilute iodine with water	Teat dip use increases - more dip used than udderwashes	Automated spraying of teats	Foam dips introduced	Increase in chlorine dioxide, hydrogen peroxide, lactic acids
	Reduced bacterial load in liners when teats disinfected	Iodine as teat dip	New classes of disinfectants - Quaternary ammonia, bleach, Chlorhexidine	Powdered dips introduced	Barrier dips introduced	
	Teats washed with water and rag	Low pH of first iodine dips - irritating to teats	Quaternary ammonia irritating to teats and leaves residue in milk that inhibits cheese cultures from growing	Teat conditioner – skin conditioners, pH and teat carriers		
	Inclusion of household dish soap and cleaning agent		Chlorhexidine most successful of new classes of dips			

- Research in the 1970's and 80's showed the value in pre dip
 - An example is Galton et al; "Evaluation of udder prep on intramammary infections; 1988"
- The discovery was that reducing bacteria on teats before milking reduced the incidence of new environmental mastitis cases



Pre-milking teat disinfectants

- Disinfect the skin of the teat and teat end or disinfect the manure and organic matter on the teat?
 - Dips are designed to disinfect the teat skin not manure on the teat
 - Disinfect the wrinkles, crevasses and cracks in teat skin
- Teat dip is not a wash/cleaning solution
 - Dips do contain surfactants, but the surfactants are designed to clean the teat skin
 - If teats are dirty, they need to be cleaned prior to disinfecting
 - If teat dip is used to moisten organic matter and remove organic matter from the teat, then the teat itself must be disinfected after the organic removal
 - Dipping the teat again
- What is the difference between disinfecting and sanitizing?
 - Disinfect: to destroy or inactivate bacteria and fungi
 - Sanitize: to reduce microorganisms to levels considered safe by established parameters
- Besides pasteurization, little can be done to milk at the processing plant to fix high raw bacteria levels



Pre-milking teat disinfectants

- The primary goals for using a pre-milking teat disinfectant:
 - 1. Kill bacteria
 - 2. Reduce the risk of new, environmental mastitis cases
 - 3. Loosen/clean organic material
- Is it a requirement in the US to disinfect teats prior to milking?
 - Yes
 - Milking shall be done...... "Teats shall be treated with a sanitizing solution just prior to the time of milking and shall be dry before milking."
 - PMO Item 13r. Milking Flanks, Udder and Teats
 - Pre-milking teat disinfectants are designed to meet the requirements of the PMO



Bacterial reduction and time

- Goal of teat dip is at least log-3 reduction in bacteria count
 - 3 log reduction is 1,000 time less bacteria or 99.9% reduction
 - The less bacteria on a teat at the start then the lower the overall bacteria on a disinfected teat
- 1,000,000 cfu/ml starting and log-3 reduction leads to 1,000 cfu/ml
- Is time important in terms of time to achieve log-3 reduction?
 - Time is not as important as the bacterial reduction itself
 - Most dips are evaluated for log reduction at 30 and 60 sec intervals
 - Given proper timing of the milking routine teat dip contact time should not be a concern
 - More emphasis on ending bacteria count or log reduction versus the time to ending bacteria count
- The largest portion of bacteria in raw milk typically comes from the teat skin
- At best, the most effective pre milking teat cleaning and sanitizing can reduce bacteria counts by 85%
 - The reason that we also clean teats along with disinfecting the teats



Post-milking teat disinfectant

- The primary goal for post-dipping:
 - 1. Kill bacteria
 - 2. Maintain/improve teat skin condition
 - 3. Rinse (dilute) the milk film on teat skin post-milking
 - Milk residue on teat skin is food for bacterial growth
 - 4. Control contagious bacterial spread
 - 5. Exfoliate excessive dead teat skin (hyperkeratosis?)
 - Based upon class of disinfectant



What is in a teat dip

- Germicide/Disinfectant: Compound that kills bacteria; antimicrobial
- Surfactant: Wetting agent; cleaning and penetrating organic matter on teat skin
- **Complexing agent/Solvent**: Chemical substance(s) designed to interact with a another substance to create a solution
- Skin conditioners: Skin conditioners or teat skin health aid
- Sealant: Film forming agent; teat end protectant
- Carrier: Substance used to hold product in suspension; usually H2O
- **Colorant**: Additive used to improve visibility of disinfectant



Skin conditioners

- Occlusives
 - Reduce evaporative water loss (dry, windy, cold)
 - Create a waxy barrier on skin surface
 - Lanolin, mineral oil, silicones
- Humectants
 - Water magnets (attract moisture to teat skin)
 - From air when humidity > 70%
 - Synthetic: Propylene glycol, Glycerin
 - Natural: Lactic acid, Citric acid, Glycolic acid, Malic acid, Aloe, Honey
- Emollients
 - Decreases skin roughness
 - · Act similar to occlusive when applied heavily
 - Fatty acids, Lanolin (water based), Cholesterol, structural lipids
- Exfoliants
 - Soften the "glue" that holds skin cells together
 - Increases dead cell removal or turnover (sloughing)
 - Alpha hydroxyl acids



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- What role does pH play in the development of disinfectants?
- Low pH leads to more stable storage of product
- Low pH leads to softening of teat tissue and possible irritation
 Irritation from low pH is based upon the acid used to lower pH
- pH from 2.7 12 (chlorine dioxide to bleach)
- Iodine pH of 5 8 is acceptable for teat health;
 - In the case of iodine a pH of 8.5 would cause the decomposition of iodine (I²) to iodide (I⁻), which is non-germicidal



Active ingredients

- Active ingredients in dips are called germicides
- All germicides are weakened (quenched) when they contact organic materials
 - Milk on teat skin
 - Bedding material on teat skin
 - Manure on teat skin
- Each germicide has a different risk for quenching



Classes of germicides

- Oxidative and non-oxidative
 - Oxidative:
 - In general this category is the "strongest"
 - Iodine, Chlorine dioxide, Hydrogen peroxide, Free-chlorine releasers, Ozone
 - Iodines and Chlorine dioxides are the most resistant to quenching
 - Hydrogen peroxides and free-chlorine releases work best in herds with clean teats
 - Non-oxidative:
 - In general this category has good but targeted killing power
 - Some germicides in this category may have some "gaps" in their killing profile
 - Chlorhexidine, Acid-Anionics, Fatty acids, Alpha hydroxy acids, Beta hydroxy acids,
 - This class is best when partnered with an oxidative germicide



Bacteria and disinfection by oxidation

- Single cell
- Single loop of DNA no nucleus
 - May contain plasmid which is genetic material that could make bacteria antibiotic resistant
- Cell wall made of proteins
- Proteins comprised of Amino Acids
- Oxidizing agents remove an electron from an amino acid in the cell membrane
- Cell membrane no longer can produce proteins to maintain cell wall
- Cell wall falls apart and the result cell death





Teat dip disinfectant market share

Germicide	Action	Percent of market
Iodine	Oxidative	65
Chlorhexidine	Cell membrane disrupter	10
Chlorine dioxide	Oxidative	10
Peroxide	Oxidative	10
Bleach	Oxidative	2
Other	Non-oxidative	3

Personal industry communications to provide estimates



Summary of teat dip germicides

Germicide	concentration	рН	Price	Pathogens controlled	Comments
Iodine	0.25 - 1.0%	4 - 6.5	Moderate to high – Trend increasing	all mastitis causing bacteria, fungi, viruses and bacterial spores	
Chlorhexidine	> 0.5%	5 - 8	Moderate	most Gram+ and Gram- and some viruses	
Chlorine dioxide	0.32%	2.7 - 4	Moderate to high	Gram +, Gram-, molds, yeast and viruses	two-part mixture; 24 hour shelf life when mixed
Peroxide	0.5 - 1.0%	5.0	Low to moderate	most Gram+ and Gram- bacteria	Efficacy of disinfecting teat is concern under organic load
Bleach	4.0%	>11	Low		must dilute; most bleach 6.25%

Barrier dips

- There is not a standardized definition of a "barrier" dip (government or industry)
- Barrier dips form an acrylic or water soluble polymer around the teat
 - More difficult to remove barrier from teat as compared to conventional dip
 - Barrier needs to have an ingredient called Poly Vinyl Alcohol (PVA)
 - PVA is the material used to make laundry detergent "pods"
 - Barrier will reduce the risk of bacteria migrating through the dip when dry
- Barrier dips usually take > 10 minutes to dry
 - Sticky/tacky
 - Bedding types sticking to "tacky barrier" manure solids, sawdust, fiber
- Viscosity of barrier dips
 - Previous data has suggested that more viscous dips, like barriers are not able to move as far into the teat canal (capillary action) as conventional dips and this may be the reason that some barriers have not been proven as efficacious as conventional dips (Nickerson et al, 1990)
 - Other studies have shown that barriers reduce the bacterial load at the teat canal as compared to undipped teats (McArthur et al., 1984)
- When to use a barrier
 - Targeted to wet, muddy, extreme conditions (dry lots in rainy season) hot, humid



Pre and post dip

- Pre dip
 - Lower concentration of disinfectant
 - Control of environmental pathogens
 - Low skin conditioners
 - Surfactants for disinfecting skin of teat
 - 50% reduction in new IMI when pre dipping as compared to udder washing with use of a paper towel
- Post dip
 - Higher concentration of disinfectant
 - Control of contagious mastitis causing organisms milk residue on teat after milking
 - Protect teat end until teat end closes after milking
 - High level of skin conditioners
 - Reduces new IMI from specific mastitis causing organisms by 50 95%



Teat dip coverage

- Spraying teats may only disinfect closest surface of teat
- Proper coverage requires rotating spraying lance twice around each teat
- Towel test
 - Wrap towel around teat after dip is applied
 - No coverage on back side of teat when spraying
 - Entire teat covered with dip when using a dip cup



Dip coverage

- There is no dip on half the teat
 - No dip on side of teat facing the head
- No skin disinfectant
- No skin conditioning





Foam

- Long contact time with teat surface
- Reduced used of chemical and water
 - This has always been stated but the viscosity and chemical makeup of the dip will impact usage
- Challenges with foam?
 - Consistency of foam day over day
 - Liquid vs shaving cream
 - Teat coverage when foamer cup contacts teat surface





Dip coverage and skin condition

• Complete teat skin coverage is crucial to maintain proper skin condition









Teat health and environment

- Cold and wind chill
 - Minimizing wind is key
 - In the winter teat condition can change in 2 or 3 days
 - Tend to see more hyperkeratosis and cracking teat skin in pointed teats as compared to flat or round teats
- Wet
 - Barrier
- Sun exposure
 - Shade and aloe vera (emollient)
- Bedding type and additives
 - Drying of teat skin with manure solids seen year round
 - Bedding additives with high pH may lead to dry teat skin



Teat dips and winter weather

- Cold, windy weather and wet teats can lead to frostbite
- Make sure there are no drafts or direct wind exposures in the housing area
- What to do when winter weather conditions increase the risk of frostbite
- Cows that walk outside between the milking center and housing area are at increased risk of frostbite
- All about the drop of dip at the teat end when there are drafty conditions
- Powdered dips is designed to absorb or remove moisture from the teat
- Dip teats with normal liquid dip and then blot dry before leaving milking area



Production Services

Winter teat health

- Increase in dry skin over winter
- Concerns with "frostbite" on teats when wet teats are exposed to cold and windy temperatures
- Fresh cows especially pre-disposed to winter teat health issues
 - Increased teat/udder edema leads to poor circulation



Goal for healthy teats

- Keep teats clean, soft and healthy
- Reduce teat/udder edema in fresh animals
- Teat shape
 - Pointed teats more prone to hyperkeratosis
 - Short teats increased teat end edema because the teat did not engage the barrel of the liner
- Why are we concerned about teat skin condition?
 - Staph aureus, Strep dysgalactiae, T. Pyogenes all known to colonize the cracks of teat skin
 - Involved in necrosis of the open lesion area



Teat evaluation

- Teat health should be evaluated 3 4 times a year
 - Evaluation of bovine teat condition in commercial dairy herds: Non-infectious factors
 - to review non-infectious factors affecting short- or medium-term changes in teats
 - to propose a simple protocol for systematic evaluation of teats in commercial dairies
 - to propose guidelines for interpretation of these observations
- These teat evaluations allow you to baseline the teat health of the herd throughout the year and year over year
- Provides a "Science based" approach to evaluating changes in teat health related to changing....
 - Teat disinfectants
 - Teat disinfectant application method
 - Bedding type
 - Bedding additive
 - Liner type
 - Etc.

Categories	GOAL Percent of cows with one or more abnormal teats	Time to see changes
Firmness at teat end	<20%	Each milking
Swelling at teat base	<20%	Each milking
Teat color	<20%	Each milking
Teat end score	<20%	2 - 8 weeks
Skin condition	< 20%	Days to weeks
Open Lesions	< 5%	Days to weeks
Petechial Hemorrhage	< 10%	Days to weeks
Cows Scored		> 20% of herd



Skin condition

- Skin condition evaluated by palpating teat and feeling for roughness
 - Normal smooth, sheen, soft
 - Dry scaly, flaky or rough skin
 - Open lesions chapped, cracked and/or blackspot
- Potential causes of dry skin
 - Exposure to wet and windy conditions
 - Teats covered in mud
 - Chemical irritation
 - Manure solids may have a drying affect
- Potential ways to improve skin condition
 - Use post dips with \geq 10% emollients
 - Short-term use of high emollient teat dips
 - ≥ 50% emollient package
 - Short-term use of low pH teat dip to increase skin cell turnover rate



Proven dips

- There are so many dips on the market but few different classes of dips, thus choosing a proven dip is easy to do
- <u>Summary of peer-reviewed teat dips</u>
- Search for proven dips
 - Database: www.PubMed.com
 - Key words: Teat dip OR teat disinfectant AND efficacy OR prevention OR reduction
- Promote clients to choose dips that have efficacy data



Concentrated dip mixed on farm

- Water quality test is a must if mixing dip on farm
 - Full bacteria count of water
 - pH
 - Hardness
- Goal is to disinfect teat not the water used to mix the dip
- Ability to titrate proper concentration of dip if mixing on farm



On-farm mixing

- On-farm mixing of teat disinfectants is increasing rapidly
- Automated mixing is preferred over manual mixing
 - Important to analyze the mixing system for proper concentration
 - Chemical titration
 - Only works for germicide and not for skin conditioners
 - Marking barrels to observe weekly usage



Accidental use of acid or detergent as a teat dip – improper storage location









lodine market price

- Iodine has doubled in cost over the past five years
- Market outlook is that the price will continue to increase
- Chile and Japan and major suppliers
 - Extraction costs
 - Transportation costs



What is the best teat dip?

- How do you answer this question?
- Improved or maintained IMI
- Improved or maintained SCC
- Improved or maintained skin condition
- Not harmful to the cow or the milk supply
- The teat dip that is proven efficacious and works for the producer
- Goal of your client



Discussion

- Disinfect skin of teat
 - Not designed to "clean" teat
- Coverage of entire teat surface with teat disinfectant – think skin conditioners
- Provide skin conditioning agents multiple skin conditioners in same package
- Application methods
 - Dip cup vs foam vs spraying
- Evaluate teat health on a routine basis
- Use of proven teat disinfectants
 - Ask for third party independent research data to confirm that a specific formulation has been carefully tested



