Topical Antibacterial Products for Canine Pyoderma

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Mechanism of Action	Advantages	Disadvantages
ACETIC ACID (2%) + BORIC ACID (2%) *Available in Shampoo, Solution, Wipes*		
• Antibacterial effect at 2.5% to 5% • *In vitro* and *in vivo* studies have indicated that cutaneous pH can affect growth of skin microbiota. • In general, a pH < 4 or 5 prevents microbial growth.[1]	• A study of acetic acid/boric acid solution indicated synergistic activity of the ingredients and eradication of *Staphylococcus pseudintermedius* (acetic acid, 0.5%; boric acid, 5%)[2] • An *in vitro* study evaluating Malactic Otic solution (dechra-us.com; originally DermaPet) demonstrated inactivation of *S pseudintermedius* within 30 min of incubation.[3]	• In the most recent study, *in vitro*, acetic acid/boric acid shampoos were ineffective for both staphylococci and *Pseudomonas*.[4]
BENZOYL PEROXIDE (2.5%–5%) *Available in Gel, Shampoo, Wipes*		
• This oxidizing agent damages bacterial membranes.[5]	• Antibacterial effect can persist for 48 H • Has keratolytic, antipruritic, and degreasing properties • Increases transepidermal water loss • Decreases glandular secretions • Has a follicular flushing action • Helpful for dogs with greasy seborrhea[5]	• May need to transition to milder product to prevent over-drying as skin condition improves • Can cause cutaneous drying, erythema, and pruritus • Compared to chlorhexidene, benzoyl peroxide shampoo required a longer incubation period (30–60 min) for bacterial eradication.[4] • A recent clinical study demonstrated that benzoyl peroxide, when used as sole therapy for canine superficial pyoderma, was clinically and microbiologically inferior to chlorhexidine.[6]
CHLORHEXIDINE (2%–4%) *Available in Scrub, Shampoo, Solution, Spray, Wipes*		
• Synthetic biguanide antiseptic with broad-spectrum activity • Rapidly effective against most gram-positive and gram-negative bacteria • Causes cytoplasmic protein coagulation and damages bacterial cytoplasmic membranes[5]	• Works in the presence of organic debris, is rarely sensitizing, and has good residual activity even after 29 H on the skin • Antimicrobial activity is superior to povidone iodine and ethyl lactate, and is nondrying compared to benzoyl peroxide.[5] • Recent *in vitro* study of chlorhexidine shampoos (2%, 3%, 4%) demonstrated equivalent and excellent minimum bactericidal activity against *S pseudintermedius* (methicillin-susceptible and methicillin-resistant) at 10 min incubation time.[4]	• Can potentially irritate the skin, especially with more concentrated products
CHLOROXYLENOL *Available in Shampoo, Solution*		
• A halophenol antiseptic • Mechanism of action has been little studied; however, due to its phenolic nature, it would be expected to have an effect on microbial membranes.[7]		• *In vitro*, chloroxylenol shampoos were ineffective for both staphylococcal and *Pseudomonas* bacteria, and viable bacteria could be isolated from all shampoo dilutions at most timepoints.[4]
ETHYL LACTATE (10%) *Available in Shampoo*		
• Penetrates hair follicles and sebaceous glands, where it is hydrolyzed by bacterial lipases into lactic acid and ethanol • This action decreases skin pH, inhibits bacterial lipases, and produces a bacteriostatic and bactericidal effect.[5]	• Less likely to cause undesirable side effects compared to benzoyl peroxide	• Some studies have shown it to be less effective than chlorhexidine or that it supports bacterial growth. • *In vitro*, ethyl lactate shampoo required an incubation period of 30 to 60 min for bacterial killing.[4]

(Table continues next page.)

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An addendum to **Challenges & New Developments in Canine Pyoderma: Topical & Systemic Treatments** (March/April 2012)

Topical Antibacterial Products for Canine Pyoderma (continued)

Mechanism of Action	Advantages	Disadvantages
IODINE *Available in Shampoo, Solution, Scrub*		
• Is thought to affect protein structure by oxidizing sulfur-hydrogen (S-H) bonds of cysteine and methionine, reacting with the phenolic groups of tyrosine and NH groups in amino acids, such as arginine, histidine and lysine, to block hydrogen bonding • Also reacts with bases of nucleotides, such as adenine, cytosine, and guanine, to prevent hydrogen bonding • Alters membrane structure by reacting with carbon=carbon (C=C) bonds in fatty acids, which results in cell death[7]	• Excellent antibacterial properties	• Poor residual activity of 4 to 8 H • Higher potential for contact sensitization compared to other topicals[5]
Mupirocin (2%) *Available in Ointment*		
• Causes decreased bacterial intracellular isoleucine depletion and subsequent halting of RNA and bacterial protein synthesis[5]	• Bactericidal within 24 to 48 H of application to most gram-positive bacteria[5] • Helpful in treatment of localized canine pyodermas, such as nasal or mucocutaneous pyoderma, interdigital granulomas, canine acne, and pressure-point pyoderma	• Not effective for *Pseudomonas*
Oxychlorine Compounds *Available in Spray*		
• Hypochlorous acid damages bacterial cellular membranes in a similar mechanism of action as the neutrophil oxidative burst (critical antimicrobial mechanism of neutrophils, which involves rapid generation and release of reactive oxygen intermediates)	• Nonirritating, water-based spray • Anecdotally helpful when used Q 12 H in cases of canine pyoderma • In cases of methicillin-resistant pyoderma, is often used as adjunct therapy to bathing and conditioners +/- systemic antibiotics	• No controlled studies available
Silver Sulfadiazine (1%) *Available in Cream, Solution (Baytril Otic, bayerdvm.com)*		
• Binds to cell components, including DNA, inhibiting transcription • Interacts with thiol groups in bacterial enzymes and proteins • Precipitates proteins • Interferes with bacterial metabolism[7]	• Broad-spectrum activity • Excellent effectiveness against *Pseudomonas* • Effective *in vitro* at 0.1% • In addition to antimicrobial activity, has a beneficial effect in wound therapy by increasing epitheliazation[8]	
Triclosan *Available in Shampoo*		
• Bisphenol bactericidal agent • Specific mode of action is unknown, but it has been suggested that the primary effects are on the cytoplasmic membrane • In studies with *Escherichia coli*, triclosan at subinhibitory concentrations inhibited uptake of essential nutrients, while higher, bactericidal concentrations resulted in rapid release of cellular components and cell death.[7]		• Less effective against *S pseudintermedius* than benzoyl peroxide • Not effective against *Pseudomonas*[6]

References

1. Matousek JL, Campbell KL. A comparative review of cutaneous pH. *Vet Derm* 2002; 13(6):293-300.
2. Benson CE. *In vitro* study: Susceptibility of selected otitis external pathogens to individual and mixture of acetic and boric acids. *AAVD Proc*, 1998.
3. Haesebrouck F, Baele M, De Keyser H, et al. Antimicrobial activity of an acetic acid and boric acid solution against *Staphylococcus pseudintermedius*. *Vlaams Diergeneekundig Tijdschrisft* 2009; 78:89-90.
4. Young R, Buckley L, McEwan N, Nuttall T. Comparative *in vitro* efficacy of antimicrobial shampoos: A pilot study. *Vet Derm* 2012; 23(1):36-38.
5. Guaguere E. Review article: Topical treatment of canine and feline pyoderma. *Vet Derm* 1996; 7:145-151.
6. Loeffler A, Cobb MA, Bond R. Comparison of a chlohexidine and a benzoyl peroxide shampoo as sole treatment in canine superficial pyoderma. *Vet Rec* 2011; 169(10):249.
7. McDonnell G, Russell AD. Antiseptics and disinfectants: Activity, action, and resistance. *Clin Microbiol Rev* 1999; 12(1):147-179.
8. Geronemus RG, Mertz PM, Eaglstein WH. Wound healing. The effects of topical antimicrobial agents. *Arch Dermatol* 1979; 115(11):1311-1314.

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