<table>
<thead>
<tr>
<th>Mechanism of Action</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| **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 | • In the most recent study, *in vitro*, acetic acid/boric acid shampoos were ineffective for both *Staphylococci* and *Pseudomonas*.³ |
| **BENZOYL PEROXIDE (2.5%-5%)** | Available in Gel, Shampoo, Wipes | • 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 | • 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.⁵  
• 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 | • 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.¹ | • 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 |
### 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

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent antibacterial properties</td>
<td>Poor residual activity of 4 to 8 H</td>
</tr>
</tbody>
</table>

| | Higher potential for contact sensitization compared to other topicals |

### Mupirocin (2%)

**Available in Ointment**

- Causes decreased bacterial intracellular isoleucine depletion and subsequent halting of RNA and bacterial protein synthesis
- Bactericidal within 24 to 48 H of application to most gram-positive bacteria
- 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*

### Oxyclorexine 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
- 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

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Broad-spectrum activity</td>
</tr>
<tr>
<td></td>
<td>Excellent effectiveness against <em>Pseudomonas</em></td>
</tr>
<tr>
<td></td>
<td>Effective <em>in vitro</em> at 0.1%</td>
</tr>
<tr>
<td></td>
<td>In addition to antimicrobial activity, has a beneficial effect in wound therapy by increasing epitheliazation</td>
</tr>
</tbody>
</table>

### 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
- Less effective against *S. pseudintermedius* than benzoyl peroxide
- Not effective against *Pseudomonas*

### References


Courtesy of Today’s Veterinary Practice (todaysveterinarypractice.com).
An addendum to Challenges & New Developments in Canine Pyoderma: Topical & Systemic Treatments (March/April 2012)