Residual antibacterial activity of canine hair treated with topical antimicrobial sprays against *Staphylococcus pseudintermedius* in vitro

Mollie L. Mesman*, Allison L. Kirby*, Wayne S. Rosenkrantz† and Craig E. Griffin‡

*Animal Dermatology Clinic, 4834 Lincoln Boulevard, Marina del Rey, CA 90293, USA
†Animal Dermatology Clinic, 2965 Edinger Avenue, Tustin, CA 92780, USA
‡Animal Dermatology Clinic, 5610 Kearny Mesa Road, San Diego, CA 92111, USA

Correspondence: Mollie L. Mesman, Animal Dermatology Clinic, 4834 Lincoln Boulevard, Marina del Rey, CA 90293, USA. E-mail: mmesman@adcmg.com

Background – Topical antimicrobial therapy is increasingly important in the treatment of canine pyoderma as the incidence of multidrug resistance has risen. However, little information is reported on the persistence of activity of topical antimicrobial products.

Objective – To determine the residual antibacterial activity of canine hairs treated with antimicrobial sprays.

Animals – Twelve privately owned dogs with no history of dermatological disease.

Methods – Dogs were treated once with four different spray products [(A) 1% chlorhexidine digluconate, (B) 2% miconazole nitrate, 2% chlorhexidine gluconate, tromethamine USP/disodium EDTA (TrizEDTA), (C) 3% chlorhexidine gluconate, phytosphingosine salicyloyl and (D) 4% chlorhexidine gluconate, TrizEDTA] in separate 5 × 5 cm sections on the trunk. Hairs were collected via shaving before, one hour after and 2, 4, 7 and 10 days after treatment. Hairs were incubated on agar plates streaked with *Staphylococcus pseudintermedius* for 24 h and the bacterial growth inhibition zone around the hairs was measured.

Results – There were significant overall treatment and day (P < 0.0001) differences in inhibition zones. The largest zones of inhibition were from hairs treated with spray B, followed by sprays D, C and A, respectively. All sprays demonstrated residual antimicrobial activity for the ten days evaluated.

Conclusions and clinical significance – Results suggest that the efficacy of an antimicrobial spray is dependent on both the concentration and combination of active ingredients. Several ingredient profiles appear to effectively inhibit *S. pseudintermedius* growth for at least 10 days, which may be beneficial in the treatment of canine pyoderma.

Introduction

Superficial pyoderma is among the most common conditions encountered in small animal medicine. The pathogen most typically isolated from dogs with superficial pyoderma is *Staphylococcus pseudintermedius*, although other staphylococcal species and other genera of bacteria may be involved.¹ The recommended management of superficial pyoderma consists of identification and control of underlying causes, utilization of topical therapy and, if indicated, systemic antimicrobial drugs.² –⁴ Over the past decade, infections associated with meticillin-resistant *Staphylococcus* spp. (MRStaph) have increased in prevalence. Rates of meticillin resistance in *S. aureus*, *S. intermedius* and *S. schleiferi* from small animal infection isolates were reported to be 35%, 17% and 40%, respectively, in a study conducted between 2003 and 2004.⁵ Another study documented an 11.4% increase in meticillin resistance in *Staphylococcus* spp. between 2002 and 2009.⁶ There has also been an increase in the number of multidrug-resistant staphylococcal infections in dogs.⁷ The emergence of multidrug resistance in veterinary medicine has led to reduced treatment options resulting in increases in morbidity, mortality and treatment costs.³ –⁷ Several studies have shown a link between systemic antimicrobial use and the development of antimicrobial resistance.⁸ –¹⁰ Additionally, antimicrobials may be accompanied by a variety of adverse systemic effects.¹⁰ In particular, multiple commonly used antimicrobials for meticillin-resistant *S. pseudintermedius* (MRStaph), including chloramphenicol, rifampicin, amikacin and the sulfa drugs, have been associated with significant adverse events.¹⁰ –¹² Therefore, conservative use of systemic antimicrobials has become crucial and effective topical therapy is often sought as an alternative.

The management of pyoderma is complicated by the canine hair coat and the hair follicle is the target site of most forms of canine pyoderma.¹,¹³ The use of topical therapy is more difficult in areas of haired skin as the hair obstructs the skin lesions.¹⁴ It has been shown that the
mouth, nose and anus are important sources of *S. pseudintermedius* which suggests that the organism is seeded from these body orifices to the haired skin.\(^\text{15}\) The distal hair shaft may then act as a trap for bacteria in the environment and it has been shown that more bacteria can be isolated from the distal hair shaft than from the skin at multiple locations on the body.\(^\text{16}\) It is possible that the presence of residual topical antimicrobial agents on the hair shaft may inhibit infection and bacterial reproduction. Thus, topical antimicrobial products may serve two functions: to treat the pyoderma and help prevent re-infection from bacteria present on the hair shafts.

In order for topical antimicrobial therapy to be effective, the active ingredients as well as the mode of delivery must be considered. There are several options for topical therapy including shampoos, creams, ointments, sprays and wipes. The selection should be based on the individual needs of the patient, the affected body location, the length and thickness of the hair coat and the ability and compliance of the owner. Spray delivery of active agents is a convenient option that can be used directly on affected body sites and results in higher concentrations and possible residual activity. Sprays can also be applied with a cotton ball when treating areas that require more restricted site application (i.e. around eyes or other mucocutaneous junctions) or animals that resent the spray mechanism. Sprays may be used alone or as an adjunctive therapy to shampooing or other delivery systems.\(^\text{17,18}\)

Several studies have evaluated the use of antimicrobial shampoo therapy for the treatment of superficial pyoderma. In some studies, less than daily shampooing was effective, suggesting possible prolonged antimicrobial efficacy.\(^\text{19,20}\) One study investigated the residual antibacterial activity of dog hairs after antimicrobial shampoo therapy.\(^\text{14}\) In that study, dogs were treated with six antimicrobial shampoos and the combination of one shampoo and conditioner. Hairs were collected immediately after treatment and 2, 4 and 7 days after the last shampoo therapy and placed onto a plate streaked with *S. pseudintermedius*. The largest zones of bacterial growth inhibition were seen after shampoos containing 2% chlorhexidine and hydrocortisone (Pinnacle\textsuperscript{TM} Dog & Cat Clean ‘N Cool\textsuperscript{TM} Antipruritic Spray, NDC, Inc.; La Vergne, TN, USA); Spray B: 2% miconazole nitrate, 2% chlorhexidine gluconate and tromethamine USP/disodium EDTA dihydrate (TrizEDTA) (MiconaHex\textsuperscript{TM} Spray, Dechra Veterinary Products; Overland Park, KS, USA); Spray C: 3% chlorhexidine gluconate and phytosphingosine salicyloyl (DOUXO\textsuperscript{TM} Chlorhexidine PS Micro-emulsion Spray; Ceva Animal Health, LLC); and Spray D: 4% chlorhexidine gluconate and TrizEDTA (TrizCHLOR\textsuperscript{TM} 4 Spray Conditioner; Dechra Veterinary Products).

All dogs were treated with two pumps of each spray and the sterile saline control once on Day 0 by an assistant. The sprays were applied to the rectangular sections on the dogs’ trunks from a distance of about 7 cm in a randomized fashion. All sites were blocked physically to prevent dispersal to the adjacent sections. After the spray was applied, it was gently massaged into the hair coat to drugs or any topical therapies in the 4 weeks prior to enrolment or throughout the duration of the study. Any dogs that developed an adverse reaction or exhibited signs of systemic illness during the study period were excluded. Dogs were required to wear Elizabethan collars whenever they were not directly supervised to prevent removal of the sprays by licking.

**Pre-treatment bathing and preparation for spraying**

On Day –3, all dogs were bathed in a maintenance shampoo containing no active antimicrobial agents (DOUXO\textsuperscript{TM} Maintenance Shampoo, Ceva Animal Health, LLC; Lenexa, KS, USA) in order to remove debris from the hair coat. All dogs were bathed in the same manner by soaking in warm water until the coat was wet, applying the shampoo and massaging it into the coat until entirely lathered. The coat was then rinsed thoroughly with water and the dogs were towel dried. On Day 0 prior to the spray treatments, clippers were used to outline five 5 cm\(^2\) rectangular sections on the trunk of each dog to distinguish where the sprays were to be applied (Figure 1). There were three sections on the right side of the trunk and two sections on the left side of the trunk. All sections were placed 5 cm apart.

**Therapeutic intervention**

Four different sprays and one sterile saline control were used on each dog. New gloves were worn for application of each spray. All dogs were treated with the following spray products: Spray A: 1% chlorhexidine digluconate and hydrocortisone (Pinnacle\textsuperscript{TM} Dog & Cat Clean ‘N Cool\textsuperscript{TM} Antipruritic Spray, NDC, Inc.; La Vergne, TN, USA); Spray B: 2% miconazole nitrate, 2% chlorhexidine gluconate and tromethamine USP/disodium EDTA dihydrate (TrizEDTA) (MiconaHex\textsuperscript{TM} Spray, Dechra Veterinary Products; Overland Park, KS, USA); Spray C: 3% chlorhexidine gluconate and phytosphingosine salicyloyl (DOUXO\textsuperscript{TM} Chlorhexidine PS Micro-emulsion Spray; Ceva Animal Health, LLC); and Spray D: 4% chlorhexidine gluconate and TrizEDTA (TrizCHLOR\textsuperscript{TM} 4 Spray Conditioner; Dechra Veterinary Products).

All dogs were treated with two pumps of each spray and the sterile saline control once on Day 0 by an assistant. The sprays were applied to the rectangular sections on the dogs’ trunks from a distance of about 7 cm in a randomized fashion. All sites were blocked physically to prevent dispersal to the adjacent sections. After the spray was applied, it was gently massaged into the hair coat to

![Figure 1. Study participant prior to spray treatments. Each 5 cm\(^2\) section indicated by the white triangles was treated with a different spray product. The white star indicates the area between the sections that was sampled to ensure there was no dispersal of sprays to adjacent sections.](image)

**Materials and methods**

**Animals**

Twelve privately owned dogs with no history or evidence of dermatological diseases based on clinical examination were included in this study. The study population included seven mixed breed dogs and one each of the following breeds: Boston terrier, Australian shepherd, miniature schnauzer, Cavalier King Charles spaniel and Pomeranian. Dogs were excluded if they had received systemic antimicrobial
evenly disperse it throughout the section. The sprays were allowed to dry for 1 h.

Specimen collection and processing
All samples throughout the study were collected by a single blinded investigator. A sample of hair was collected with 5/8″ clippers (Oster; Boca Raton, FL, USA) from the trunk of each dog on Day 0 prior to spray treatments to ensure that there was no antimicrobial activity of the maintenance shampoo. Hair was collected with clippers from the treated sections on days 0 (1h post-treatment), 2, 4, 7 and 10. Hair was also collected from the areas between the treated sections (Figure 1) at the same time points to ensure that the sprays did not diffuse to adjacent sections. A different clipper blade was used for each section and the blade was carefully cleaned between dogs with sterile saline and a toothbrush.

A clinical isolate of *Staphylococcus pseudintermedius* showing no antimicrobial resistance was cultured according to the methods previously reported and distributed on a Mueller-Hinton-2-agar plate (Hardy Diagnostics; Santa Maria, CA, USA). In accordance with the aforementioned study, collected hair samples were weighed individually and 0.02 g were arranged in a tight bundle, lightly wetted with sterile water and placed flat onto the prepared agar plate with a sterile forceps (Figure 2). The plates were incubated for 24 h at 37°C in aerobic conditions. All cultures were performed in duplicate. The extent of bacterial growth inhibition was assessed by measuring the perpendicular distance from the middle of the hair bundle between tips and base to the edge of the bacterial growth inhibition zone on both sides (Figure 2). The final measurement was calculated as the average of the four measurements (two values in duplicate).

Statistical analysis
All analyses were performed using SAS v.9.3 (Cary, NC, USA). All four values (two sides and two duplicate values) were averaged for each dog and treatment prior to analysis. A repeated measure analysis of variance using PROC MIXED in SAS was used to test for differences in the extent of the bacterial growth inhibition zone between the four treatments and 5 days. The full model included fixed factors of treatment and day and a random intercept for each dog. Multiple comparisons were adjusted for using a Tukey-Kramer Honestly Significant Difference (HSD) test. An unstructured covariance structure was used. All hypothesis tests were two-sided and the significance threshold was set to 0.05.

Results
All dogs tolerated each antimicrobial spray with no adverse effects and completed the study. No hairs from the pre-treatment samples of any dog showed inhibition of growth. Additionally, no hairs from the sterile saline control group or the sections between treatment areas showed a zone of bacterial growth inhibition on any of the days and thus were not included in the analysis.

Spray A had a significantly lower inhibition zone than all other treatments and at all time points \( P < 0.0001 \) with the exception of Spray C on Day 0 \( P = 0.149 \). Spray B had a significantly higher inhibition zone than Spray C on Day 7 \( P = 0.049 \). The mean widths of bacterial growth inhibition for each treatment group at each time point are shown in Table 1. Spray A had a significantly lower inhibition zone over all days than Sprays B, C and D \( P < 0.0001 \) for each comparison). Spray C had a significantly lower inhibition zone over all days than Spray B \( P < 0.0001 \) and Spray D \( P = 0.001 \) and Spray D had a significantly lower inhibition zone over all days than Spray B \( P = 0.013 \).

Discussion
The present study evaluated the residual antibacterial activity of canine hair treated with four antimicrobial sprays. All sprays showed antibacterial activity for the entire 10 days and the largest zones of bacterial growth inhibition were seen by the spray containing 2% miconazole/2% chlorhexidine gluconate/TrizEDTA followed by

Figure 2. Plate A contains hair treated with the saline control. Note the lack of bacterial growth inhibition. Plate B contains hair treated with Spray D (4% chlorhexidine, TrizEDTA). The arrows represent the two measurements obtained which were then averaged to determine bacterial growth inhibition for each spray product tested.
TrizEDTA/4% chlorhexidine gluconate, 3% chlorhexidine gluconate/phytosphingosine and, finally, 1% chlorhexidine gluconate/hydrocortisone.

Similar to previous findings, the bacterial inhibition zone sizes did not correlate directly with the concentration of chlorhexidine because the spray containing 2% miconazole, TrizEDTA and 2% chlorhexidine had a larger inhibition of bacterial growth than the sprays containing 4% chlorhexidine and 3% chlorhexidine. Possible explanations for this include differences in spray formulation as well as the presence of additional active ingredients, such as miconazole and TrizEDTA, creating individual and/or synergistic bactericidal effects.

Miconazole is an imidazole antifungal agent that also has antibacterial efficacy against several types of bacteria. At low concentrations, miconazole has been shown to be bactericidal against S. aureus by destabilizing bacterial cell membranes. Miconazole has also been shown to have synergistic effects with certain antimicrobials. One study evaluated the combination of polymixin B and miconazole against certain Gram-negative and Gram-positive bacteria and yeast. The mean fractional inhibitory concentration index (FICI) for S. intermedius did not show an overall synergistic action, but for some individual strains it was synergistic and there was an eight-fold reduction of the individual minimum inhibitory concentrations (MICs) when both drugs were used. Synergism did occur for Escherichia coli, Pseudomonas aeruginosa and Malassezia pachydermatis, and the drug combination reduced the MICs from four-fold to a hundred-fold. Another study demonstrated synergistic growth inhibition of Microspor canis by miconazole and chlorhexidine and showed that a 1:1 combination of both agents was more effective than either agent alone for nine of ten isolates. A previous study found that the shampoo containing 2% chlorhexidine gluconate and 2% miconazole had larger zones of bacterial growth inhibition than both the 3% chlorhexidine gluconate and the 4% chlorhexidine gluconate shampoos. Likewise, the present study showed that the spray containing 2% miconazole and 2% chlorhexidine gluconate had the largest zones of inhibition. Since the completion of this study, a publication has shown a synergistic action of miconazole and chlorhexidine against 12 of 49 strains of MRSP and 23 of 49 meticillin-sensitive S. pseudintermedius. The results of the present study and the prior shampoo study may suggest a residual synergistic inhibition of S. pseudintermedius growth by the combination of miconazole and chlorhexidine and could be the subject of future studies.

Both products with the largest inhibition zones in the present study contained TrizEDTA, an antibacterial potentiating agent which contains tromethamine (Tris) edetate disodium dihydrate (EDTA) buffered to a pH of 8 with tromethamine hydrochloride and deionized water. The EDTA damages the cell surface of Gram-negative bacteria, which facilitates drug penetration. The Tris buffer enhances the effect of the EDTA. The compound is commonly used to increase the efficacy of certain antibacterials when treating Gram-negative bacteria such as P. aeruginosa, Proteus mirabilis and E. coli. There are also reports of the efficacy of EDTA-Tris in the treatment of Gram-positive organisms. Several studies have evaluated the use of chlorhexidine gluconate potentiated with EDTA-Tris. One study showed that the combination of chlorhexidine and EDTA-Tris was more active than chlorhexidine alone when used to treat several organisms, including E. coli, Proteus mirabilis, Pseudomonas spp., S. aureus, S. epidermidis and Streptococcus faecalis. A previous study evaluated the in vitro antimicrobial activity of a chlorhexidine/EDTA-Tris ear antiseptic and found that the product was active against the most common pathogens associated with canine otitis, including Gram-negative and Gram-positive bacteria such as S. pseudintermedius. The results of the present study may support that the combination of chlorhexidine with TrizEDTA is more effective than chlorhexidine alone. However, there was no comparison of two products of the same chlorhexidine concentration with and without TrizEDTA. Future studies could be aimed at comparing chlorhexidine/TrizEDTA and chlorhexidine alone against S. pseudintermedius.

The results of the present study indicate that after one spray treatment with the tested products there is residual antibacterial activity for up to 10 days on hair shafts. However, it is likely that the sprays last longer than the 10 days evaluated given the persistence of bacterial growth inhibition on the last day. A longer study period would be needed to show the entire duration of residual antibacterial activity. Given these results, treatment with antimicrobial sprays may be an effective and convenient adjunctive therapy to shampooing as patients can be sprayed between baths. This study evaluated the residual antibacterial activity of the hair shafts in vitro after they were treated with one spray treatment. It is unknown to what degree the spray reaches the hair follicle and if the spray’s presence on the hair will correlate with residual antibacterial activity in vivo and have clinical significance.

Table 1. Widths of bacterial growth inhibition zones (in millimeters; mean ± standard deviation) around hairs after treatment with antimicrobial sprays after 1 h (day 0) and 2, 4, 7 and 10 days.

<table>
<thead>
<tr>
<th>Spray</th>
<th>Ingredients</th>
<th>Day 0</th>
<th>Day 2</th>
<th>Day 4</th>
<th>Day 7</th>
<th>Day 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1% chlorhexidine gluconate</td>
<td>5.04 ± 0.86</td>
<td>2.75 ± 1.34</td>
<td>2.17 ± 2.06</td>
<td>1.88 ± 1.43</td>
<td>0.85 ± 1.06</td>
</tr>
<tr>
<td>B</td>
<td>2% chlorhexidine gluconate</td>
<td>7.81 ± 0.82</td>
<td>7.44 ± 1.88</td>
<td>7.48 ± 1.90</td>
<td>8.06 ± 3.15</td>
<td>6.02 ± 1.64</td>
</tr>
<tr>
<td></td>
<td>2% miconazole</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TrizEDTA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>3% chlorhexidine gluconate</td>
<td>6.73 ± 0.76</td>
<td>5.92 ± 0.94</td>
<td>5.79 ± 1.26</td>
<td>6.17 ± 1.46</td>
<td>4.17 ± 0.86</td>
</tr>
<tr>
<td></td>
<td>phytosphingosine salicyloyl</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>4% chlorhexidine gluconate</td>
<td>8.42 ± 1.07</td>
<td>6.73 ± 1.21</td>
<td>7.13 ± 1.58</td>
<td>6.46 ± 1.60</td>
<td>4.48 ± 1.45</td>
</tr>
<tr>
<td></td>
<td>TrizEDTA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

© 2016 ESVD and ACVD, Veterinary Dermatology, 27, 261–e61.
In addition to the short study period, other potential limitations of this study should be considered. One was the inclusion of dogs with all hair types which the authors preferred as it would reflect more accurately what is dealt with in clinical practice. However, the study would have been more standardized if a single coat type had been used. The sprays were left in their original bottles to replicate their usage in practice and this may have resulted in different volumes of spray being applied depending on the spray used. Additionally, the results of this study are representative of a single clinical isolate of *S. pseudintermedius*. Future studies are needed to evaluate the residual antibacterial efficacy of the sprays against different isolates, as well as other bacterial species.

In conclusion, results of this study support the use of antimicrobial sprays in the treatment and/or prevention of canine pyoderma as they provide residual antibacterial activity, at least on the hair shafts. This may allow use of sprays at less frequent intervals than once daily, as some products produced zones of bacterial inhibition within 70% of the Day 0 values.

**Acknowledgements**

The authors would like to thank: Tracy Yen, Kimby Lo, Ashley Bourgeois, Desiara Foist-Wheatcraft, Brenda Hernandez, Danielle Taylor and Frank Alvarado for providing dogs for the study; Jolande Leigh with California Micro Reference Laboratories; Deborah Keys for assistance with statistical analysis; and Dehra Veterinary Products, Ceva Animal Health and Pinncalife Animal Health for providing products for this study.

**References**


**Résumé**

**Contexte** — Le traitement antimicrobien topique est d’importance croissante dans la gestion des pyodermites canines vu l’augmentation de l’incidence des multirésistances. Cependant, peu d’informations sont rapportées sur la persistance de l’activité de produits antimicrobiens topiques.

**Objectifs** — Déterminer l’activité antibactérienne résiduelle des poils de chien testés avec des sprays antimicrobiens.

**Méthodes** — Les chiens ont été traités une fois avec quatre différents sprays [(A) digluconate de chlorhexidine à 1%, (B) nitrate de miconazole à 2%, gluconate de chlorhexidine à 2%, tromethamine USP/disodium EDTA (TrizEDTA), (C) gluconate de chlorhexidine à 3%, phytosphingosine salicyloyl et (D) gluconate de chlorhexidine 4%, TrizEDTA] dans des sections séparées du tronc. Les poils ont été prélevés par tonte avant, une heure et 2, 4, 7 et 10 jours après traitement. Les poils ont été incubés sur gélose ensemencée par *Staphylococcus pseudointermedius* pendant 24h et la zone d’inhibition de croissance bactérienne autour des poils a été mesurée.

**Résultats** — Il y avait des différences significatives pour le traitement et le jour (*P* < 0.0001) pour les zones d’inhibition. Les zones les plus larges d’inhibition correspondaient aux poils traités avec le spray B, puis les sprays D, C et A respectivement. Tous les sprays ont démontré une activité antimicrobienne résiduelle pour les dix jours évalués.

**Conclusions et importance clinique** — Les résultats suggèrent que l’efficacité d’un spray antimicrobien dépend à la fois de la concentration et de la combinaison des composés actifs. Plusieurs composés apparaissent efficaces sur l’inhibition de la croissance de *S. pseudointermedius* pendant au moins 10 jours ce qui pourrait être utile dans le traitement des pyodermites canines.

**Resumen**

**Introducción** — La terapia tópica antimicrobiana está adquiriendo mayor importancia en el tratamiento de la pioerderma canina a medida que la incidencia de resistencia antimicrobiana está creciendo. Sin embargo existe poca información publicada de la consistencia de actividad antimicrobiana de los productos tópicos.

**Objetivo** — determinar la actividad antibacteriana residual en pelos caninos tratados con pulverizados antimicrobianos.

**Animales** — 12 perros de propietarios privados sin historia de enfermedad de la piel.

**Métodos** — los perros fueron tratados una vez con cuatro productos diferentes pulverizados [(A) 1% de digluconato de clorhexidina, (B) 2% de nitrito de miconazol, 2% de gluconato de clorhexidina, trometamina USP/EDTA disódico (TrizEDTA), (C) 3% de gluconato de clorhexidina, saliciloil fitosfingosina y (D) 4% de gluconato de clorhexidina, TrizEDTA] en áreas separadas de 5 9 5 centímetros en el tronco. Los pelos se recolectaron mediante afeitado antes, una hora después y a los en las 2, 4, 7 y 10 días tras el tratamiento. Los pelos se incubaron en placas de agar cultivadas con *Staphylococcus pseudointermedius* durante 24 horas y se midió la inhibición del crecimiento bacteriano alrededor del pelo.

**Resultados** — hubo diferencias significativas en todos los días y tratamientos en las zonas de inhibición (*P* <0,0001). Las zonas mayores de inhibición se formaron en los pelos tratados con pulverizado B seguidos por los pulverizados D, C y A, respectivamente. Todos los pulverizados demostraron actividad antimicrobiana durante los 10 días evaluados.

**Conclusión e importancia clínica** — los resultados sugieren que la eficacia de un pulverizado antimicrobiano depende tanto de la concentración, como de la combinación de ingredientes activos. Perfiles de varios ingredientes parecen ser efectivos para inhibir el crecimiento de *S. pseudointermedius* durante al menos 10 días, lo cual puede ser beneficioso en el tratamiento de la pioederma canina.

**Zusammenfassung**


**Ziele** — Die Bestimmung der residualen antibakteriellen Aktivität von Hundehaar, die mit antimikrobiellen Sprays behandelnden worden waren.

**Tiere** — Die Hunde wurden einmal mit vier verschiedenen Sprayprodukten [(A) 1% Chlorhexidin Diglukonat, (B) 2% Miconazol Nitrat, 2% Chlorhexidin Glukonat, Tromethamin USP/Disodium EDTA (TrizEDTA), (C) 3%
Chlorhexidin Glukonat, Phytosphinsinosin Salicyloyl und (D) 4% Chlorhexidin Glukonat, TrizEDTA in separaten 5 x 5 cm Abschnitten am Rumpf behandelt. Es wurden durch Rasur vorher und eine Stunde und 2, 4, 7 und 10 Tage nach der Behandlung Haare gesammelt. Die Haare wurden auf Agarplatten, auf denen Staphylococcus pseudintermedius ausgestrichen war, 24h lang inkubiert und die Inhibitionszonen, die rund um die Haare das bakterielle Wachstum verhinderten, wurden gemessen.


**Schlussfolgerung und klinische Bedeutung** – Die Ergebnisse weisen darauf hin, dass die Wirksamkeit eines antimikrobiellen Sprays sowohl von der Konzentration wie auch der Kombination der aktiven Wirkstoffe abhängt. Mehrere Inhaltsprofile scheinen das Wachstum von S. pseudintermedius für mindestens 10 Tage zu inhibieren, was bei der Behandlung der Pyodermie des Hundes von Vorteil sein kann.

**より**

**背景** – 多剤耐性の出現により、外用抗菌療法はイヌの膿皮症の治療において重要性を増している。しかし、外用抗菌製剤の活用状態を報告した情報はほとんどない。

**目的** – 抗菌スプレーで処置したイヌの被毛に残存する抗菌活性を決定すること。

**供与動物** – 皮膚疾患のない、12頭の個人的に所有されたイヌ。

**方法** – イヌを体幹部に5 x 5 cmの領域に4種類の異なるスプレーを各10日間、(A) 1% ゲルコン酸クロルヘキシジン, (B) 2% ゲルコン酸クロルヘキシジン・トラメタミン・シグナル化物・ストリプトマイシン・エデタナトリウム (TrizEDTA), (C) 3% ゲルコン酸クロルヘキシジン・サリチル酸フチゾシンおよび(D) 4% ゲルコン酸クロルヘキシジン, TrizEDTA で処置した。被毛は処置前、1時間後および2, 4, 7, 10日後に毛切りして回収し、被毛はStaphylococcus pseudintermediusを植菌した寒天培地で4時間培養し、被毛周辺の細菌増殖阻止領域を測定した。

**結果** – 阻止領域において、全体として治療および日数に有意差(P < 0.0001)がみられた。最も大きな阻止領域はスプレーBで処理した被毛から得られ、その次はスプレーD、C、Aの順であった。すべてのスプレーにおいて評価した10日間残存する抗菌活性が示された。

**結論および臨床的な重要性** – 今回の結果から抗菌スプレーの効果は濃度および活性成分の組み合わせの両方に依存することが示唆された。複数の成分内容は少なくとも10日間 S. pseudintermedius の増殖を効果的に阻止すると考えられ、イヌの膿皮症の治療において有益な可能性がある。

**要約**

**背景** – 犬の皮膚病治療中多重耐薬率増加の問題、外用抗生物質治療の重要性を実証した。そして、外用抗菌薬の活性についての報告は少ない。

**目的** – 実験的ドッグにおける抗生物質の活性を評価すること。

**動物** – 12匹の健康なドッグ。

**方法** – 分別して腹部に5 x 5 cmの領域に4種類の異なるスプレーを、各10日間、(A) 1% ゲルコン酸・クロルヘキシジン, (B) 2% ゲルコン酸・クロルヘキシジン・トラメタミン・シグナル化物・ストリプトマイシン・エデタナトリウム (TrizEDTA), (C) 3% ゲルコン酸・クロルヘキシジン・サリチル酸フチゾシンおよび(D) 4% ゲルコン酸・クロルヘキシジン, TrizEDTA で処理した。被毛は処置後、1, 2, 4, 10日後に毛切りして回収し、被毛はStaphylococcus pseudintermediusを植菌した寒天培地で4時間培養し、被毛周辺の細菌増殖阻止領域を測定した。

**結果** – 各スプレーの効果は濃度および活性成分の組み合わせの両方に依存することが示唆された。これより、複数の成分内容は少なくとも10日間 S. pseudintermedius の増殖を効果的に阻止することが示唆された。