Influence of dog appeasing pheromone (DAP) on dogs housed in a long-term kennelling facility

E. K. Grigg,¹,² M. Piehler¹

ABSTRACT
Introduction: Kennel facilities are commonly acknowledged as a stressful environment for many domestic dogs (Canis familiaris). One therapeutic measure used to reduce anxiety in dogs is dog appeasing pheromone (DAP), which has been found effective in reducing stress-related behaviours in a number of contexts.

Aims and Objectives: A pilot study was conducted to assess whether DAP would reduce frequency of stress-related behaviours in a group of eight dogs housed for teaching purposes in a long-term kennelling facility.

Materials and Methods: Using video analysis, proportion of time spent in stress-related behaviours for six dogs fitted with DAP collars, versus two control dogs (without collars), was compared for the time before and during DAP exposure.

Results: No significant differences were found either in the proportion of time spent in stress-related behaviours in the baseline versus treatment periods or in the proportion of time spent in stress-related behaviours in the baseline versus treatment periods.

Conclusions: Possible reasons for these findings include an actual lack of effect of DAP on dogs housed in this long-term kennelling facility, an apparent lack of effect due to small sample size in this pilot study and high behavioural variation among individual dogs.

INTRODUCTION
Canine kennel facilities are commonly acknowledged as a stressful environment for many dogs. Compulsive and repetitive behaviours can develop in these dogs, due to confinement and boredom, crowding or social isolation (Pryor 2002, Hart and others 2006). Methods used to reduce stress in dogs range from environmental enrichment (Wells 2004) to psychotropic medications (e.g. Seksel and Lindeman 2001, Landsberg and others 2008). One non-invasive therapeutic measure used to reduce anxiety in dogs is dog appeasement pheromone (DAP). DAP mimics the properties of the natural pheromones of the lactating female that are believed to give their puppies a sense of well-being and reassurance. DAP has been found effective in reducing stress-related behaviours in a number of contexts, for example, noise phobias in owned dogs (Sheppard and Mills 2003) and stresses associated with traditional shelters (Tod and others 2005). However, a recent review found that many pheromone studies provided insufficient evidence of effectiveness (Frank and others 2010), suggesting that further research is still needed to assess their efficacy.

Ross University School of Veterinary Medicine (RUSVM), located in St. Kitts, West Indies, houses a colony of domestic dogs used in teaching students. Dogs are donated to the programme; therefore, the number in the colony (usually 25–30 dogs) and length of stay (up to two years) varies. The length of stay for some of the RUSVM dogs was a concern to the dogs’ caretakers, as before this study, a number of colony dogs had been identified as exhibiting repetitive behaviours (spinning, continual barking, jumping on kennel doors and walls). These types of behaviours were likely a result of ‘kennel stress’ (see Pryor 2002).

Earlier studies of DAP in a kennelling environment used electronic DAP diffusers and shorter exposure times, for example, seven
days (Tod and others 2005) or were performed using dogs with a shorter residence time in the kennels facility (at two and 10 days after admission; Barlow and Goodwin 2009). The authors wished to assess whether DAP (in collar form) would reduce frequency of stress behaviours in dogs living in a long-term kennelling facility. A pilot study was conducted to compare frequency of stress-related behaviours in the presence and absence of DAP.

MATERIALS AND METHODS

Study animals and video data collection

For this study, eight dogs were randomly selected from among those identified as exhibiting repetitive behaviours in the RUSVM kennels. Seven of the eight dogs (87.5 per cent) used in the study were adult males; of these, five were neutered (Table 1). Length of stay at the start of the study ranged from two to 24 months (Table 1). These dogs were filmed in their kennels for 20 minute periods, at consistent but alternating times of day (morning and evening, to minimise temporal bias) for 20 days; this time period was selected as the authors felt it would provide sufficient data for comparison with later (treatment period) video, but would make the time-consuming process of watching and transcribing the video accomplishable in a reasonable time period for student research assistants. Filming times were selected to coincide with times when the dogs’ schedules were most predictable (e.g. not during lab start times, when some dogs were temporarily removed from the facility for use in teaching labs). High-definition video cameras (Flip MinoHD video camcorders; Cisco Systems, San Jose, California, USA) were used to film the dogs; videographers were not in view of the dogs during filming.

After 20 days, six of the dogs were randomly selected to be given collars infused with DAP (Adaptil; Ceva Animal Health, Lenexa, Kansas, USA); two dogs did not receive collars (Table 1). Filming continued on the same schedule for the next 21 days; this time period was selected for the reasons noted above for the baseline video filming. Video observers were trained by the senior author (EKG) to consistently and correctly identify all focal behaviours seen. Each video recording was watched by a trained observer and durations of time that the dogs were engaged in stress-related behaviours (barking, spinning, pacing, jumping and active vigilance, i.e. dog is standing inside the kennel, staring fixedly at something outside the kennel) were noted. Time spent resting or sleeping was also recorded, as it was felt that an increase in resting behaviour could help reveal a concurrent decrease in repetitive, stress-related behaviours. Behavioural data were recorded from 62.2 total hours of video. Placebo collars were not placed on the control dogs, but all dogs wore both traditional buckle collars and tick collars, obscuring the video observers’ view of the DAP collar. In addition, video observers were not told which dogs received collars or when the collars were put on the dogs.

Statistical analyses

Durations of stress-related and resting behaviours were converted into proportion of total time budget (i.e. total time filmed) for each dog, before and during the time that DAP collars were worn by the dogs. For each collared dog, the proportion of time spent in these behaviours in the baseline (precollar) versus treatment (collars on) periods was compared, using a Wilcoxon signed-rank test for paired samples; in this way, each dog served as its own control. In addition, the difference in the proportion of time spent in a given behaviour in the baseline versus treatment period was calculated for each individual dog. Differences for the collared dogs were compared with differences for the control dogs, using a Mann-Whitney U test, to assess whether the collared dogs showed greater (or lesser) change in each behaviour than the control dogs. All statistical analyses were run in Minitab (Minitab; State College, Pennsylvania, USA) or XLSTAT (Addinsoft; Paris, France). This study was conducted in accordance with requirements of the RUSVM Institutional Animal Care and Use Committee.

RESULTS

Study animals and video data collection

Proportions of time spent in each behaviour, before and after the DAP collars were fitted, and changes in proportion of time spent in each behaviour, baseline versus treatment period, are shown (Fig 1). Most dogs spent a significant proportion of their time in their kennels resting and/or sleeping, although repetitive behaviours

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At the time of this study, DAP collars were not readily available on St. Kitts (where RUSVM is located) and were considered prohibitively expensive by kennel facility administrators; therefore, all collars available at the time of the study were active and placed on the treatment dogs.

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### TABLE 1: Characteristics of dogs enrolled in the DAP collar pilot study

<table>
<thead>
<tr>
<th>Dog</th>
<th>Sex</th>
<th>Age category*</th>
<th>Reproductive status</th>
<th>Duration of stay† (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control 1</td>
<td>M</td>
<td>OA</td>
<td>Neutered</td>
<td>19</td>
</tr>
<tr>
<td>Control 2</td>
<td>M</td>
<td>A</td>
<td>Neutered</td>
<td>24</td>
</tr>
<tr>
<td>Dog 1</td>
<td>M</td>
<td>YA</td>
<td>Entire</td>
<td>4</td>
</tr>
<tr>
<td>Dog 2</td>
<td>M</td>
<td>YA</td>
<td>Entire</td>
<td>19</td>
</tr>
<tr>
<td>Dog 3</td>
<td>F</td>
<td>A</td>
<td>Neutered</td>
<td>5</td>
</tr>
<tr>
<td>Dog 4</td>
<td>M</td>
<td>YA</td>
<td>Neutered</td>
<td>13</td>
</tr>
<tr>
<td>Dog 5</td>
<td>M</td>
<td>YA</td>
<td>Neutered</td>
<td>2</td>
</tr>
<tr>
<td>Dog 6</td>
<td>M</td>
<td>YA</td>
<td>Neutered</td>
<td>7</td>
</tr>
</tbody>
</table>

*Estimated, as many dogs are strays or rescued before joining.
†At start of study.
A, adult (four to six years); DAP, dog appeasing pheromone; OA, older adult (greater than six years); YA, young adult (two to four years).

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such as barking and jumping were seen (Fig 1). Spinning was seen too infrequently for inclusion in the statistical analyses (Fig 1).

Statistical analyses
No significant differences were found in the proportion of time DAP-collared dogs spent in stress-related behaviours in the baseline versus treatment periods. There were also no significant differences between the collared and control dogs in the change in proportion of time they spent in any of the focal behaviours in the baseline versus treatment periods (P>0.05 for all tests; Table 2).

DISCUSSION
In the present study, no significant effects of DAP collars on the behaviours selected for analysis were found; the

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Median proportion</th>
<th>Test statistic</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacing</td>
<td>0.145</td>
<td>0.135</td>
<td>4.0</td>
</tr>
<tr>
<td>Barking</td>
<td>0.005</td>
<td>0.010</td>
<td>4.0</td>
</tr>
<tr>
<td>Active vigilance</td>
<td>0.290</td>
<td>0.240</td>
<td>14.0</td>
</tr>
<tr>
<td>Resting</td>
<td>0.485</td>
<td>0.515</td>
<td>11.5</td>
</tr>
</tbody>
</table>

(b) Change in proportion of time spent in a behaviour in the baseline versus treatment period, comparing collared versus control dogs, by behaviour (n₁=6, n₂=2)

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Collared dogs</th>
<th>Control dogs</th>
<th>Test statistic</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacing</td>
<td>0.03</td>
<td>−0.05</td>
<td>29</td>
<td>0.6</td>
</tr>
<tr>
<td>Barking</td>
<td>0.00</td>
<td>−0.07</td>
<td>31</td>
<td>0.6</td>
</tr>
<tr>
<td>Active vigilance</td>
<td>−0.05</td>
<td>−0.01</td>
<td>25</td>
<td>0.2</td>
</tr>
<tr>
<td>Resting</td>
<td>0.02</td>
<td>0.18</td>
<td>25</td>
<td>0.6</td>
</tr>
</tbody>
</table>

*Positive values indicate increase in the behaviour from baseline to treatment (collar on) period, negative values indicate decrease in the behaviour from baseline to treatment period.
DAP collars may simply not have been effective in this context. One potential explanation is that the level of stress experienced in a long-term kennelling facility (such as the RUSVM kennels) was too great for DAP to have a marked effect on behaviour. At the time of this study, there was not an established enrichment programme for the dogs, dogs were not allowed to socialise with other dogs and spent the majority of their time in their individual kennels. Dogs remained in the programme for as long as two years. Longer durations of time in a kennelling facility have been associated with higher levels of behaviours associated with chronic stress (Hubrecht and others 1992), but others have stressed that quality of environment, versus length of stay, is the primary predictor of development of behavioural problems (Hetts and others 1992, Titulaer and others 2013). Repetitive behaviours such as spinning and excessive vocalisation may have been too well established in some of these dogs, or the triggers for these behaviours too common, to be significantly reduced by a DAP collar alone. Tod and others (2005) did note a significant decrease in barking in kennelled dogs exposed to DAP. However, that study used DAP diffusers (versus collars), had a larger sample size (54 dogs), but only exposed the dogs to DAP for seven days (versus 21 in the present study). As in the present study, the authors noted that they had limited control over the dogs’ daily routines. It may be important that the study of Tod and others (2005) was conducted in a traditional shelter environment (where the average length of stay of study dogs was presumably much shorter). In our data, however, there did not appear to be a consistent pattern to indicate that RUSVM dogs who had been in the kennels for a shorter period of time were more likely to gain a beneficial effect from the DAP collars (Table 1 and Fig 1). DAP may be primarily useful as an adjunct to other forms of behavioural therapy (such as increased enrichment, exercise and conspecific social interactions) in reducing or even preventing the development of stress-related, repetitive behaviours in dogs housed in a long-term kennelling facility.

Another possible explanation is that any behavioural changes associated with the DAP collars may not have been of sufficient magnitude to reach statistical significance, given the limited number of dogs available for this pilot study. In contrast, the study of Tod and others (2005) used 37 treatment and 17 control dogs. In addition, dogs were being used throughout the study for their normal teaching purposes, which varied somewhat over their environment in the kennels. However, the dogs varied as individuals, which may reflect that the collars had differing effects on different dogs. For example, three of the six collared dogs did show an increase in the proportion of time spent resting when wearing the collars, but the difference from baseline was not significant (and, one of the control dogs also showed a similar increase during the treatment period). It is possible that resting behaviour observed in the facility was a clinical sign of stress, in the sense of learned helplessness (Seligman and Maier 1967) brought on by the lack of control that these dogs had over their environment in the kennels. However, the dogs were not used in any invasive procedures, did not regularly suffer any traumatic experience, and appeared behaviourally normal in most contexts (when on walks or in labs), thus the authors interpreted resting behaviour as true resting. In addition, testing levels of stress in the dogs during resting periods was beyond the scope of this study. Temperament of a given animal will be influenced by genetic predisposition, previous life experience and hormonal state (Levine 1967, Stur 1987, Serpell and Jagoe 1995), and temperament will influence a dog’s ability to cope with stressful situations (Geverink and others 2002). Individual dogs have been found to respond in different ways to stress (e.g. Hiby and others 2006, Rooney and others 2007), and large individual variations in behaviour of kennelled dogs (Hubrecht 1995) and in dog responses to kennel conditions (Titulaer and others 2013) have been reported elsewhere.

Although the authors were not able to demonstrate a significant positive influence of the DAP collars in these dogs, the attention that the study brought to the behavioural issues seen in some of the dogs did have positive consequences. Efforts by the faculty and students involved in the study resulted in significant changes to the management of the RUSVM teaching dog colony. These dogs now have a coordinated and active enrichment and behavioural wellness programme in place, are allowed social group play time and stay in the colony for a shorter period of time, ranging from 12 to 18 months, before adoption into a suitable home.

In conclusion, the authors are confident that, for the RUSVM colony dogs in this study during this study period, DAP did not result in a consistent and marked decline in the focal stress-related behaviours. However, given the other studies reporting an impact of DAP on certain types of fear-related and stress-related behaviours and the limitations in scope of this pilot study, the authors suggest that additional research will be needed to definitively answer the question of whether DAP is beneficial for dogs housed in long-term kennelling facilities. Future analyses could be done with larger sample sizes and include evaluation of other indicators of chronic stress in dogs (such as hair cortisol analysis (Bryan and others 2013) or cognitive testing (Titulaer and others 2013)).

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