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Short Communication

The Use of Lavender Aromatherapy to Relieve Stress in Trailered Horses

Kylie Heitman [a,*], Bradley Rabquer [a], Eric Heitman [b], Craig Streu [a], Paul Anderson [a]

[a] *Department of Science, Albion College, Albion, MI*
[b] *Ottawa Animal Hospital, Holland, MI*

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A B S T R A C T

Competition horses are susceptible to high stress levels. Lavender aromatherapy (LA) is legal, has the potential to reduce stress, and is a relatively unexplored area of equine physiology. We hypothesis that LA has positive effects on helping horses cope with stress. We predict that these effects can be measured in lowered cortisol, norepinephrine, and heart rate levels in horses that have been subjected to lavender aromatherapy during a stressor. Eight horses were used in a crossover study and were transported for 15 minutes in a horse trailer. During the trailer ride (stressor), the horses received water aromatherapy as the control, and LA as the treatment. Three measurements of heart rates and blood draws were taken on each horse: (1) baseline—before loading into the trailer, (2) stressed—immediately after the trailer ride, and (3) recovery—50 minutes after the trailer ride. The blood samples were used to quantify serum cortisol levels. In both the control and treatment horses, the average difference between the baseline and stressed measurements of heart rate (HR) and cortisol increased when the horses were transported (control HR = 10.6 b/m ± 2.6 standard error [SE]; treatment HR = 9.3 b/m ± 2.6 SE; control cortisol = 3,747.2 pg/uL ± 864.2 SE; treatment cortisol = 2,511.8 pg/uL ± 1009.9 SE). In the control and treatment horses, there was no difference in the HRs of the control and treatment horses (*P*-value = .37); there was a difference in cortisol levels (*P* = .038), which provides evidence to conclude that cortisol levels were lower in horses that were subjected to LA during a stressor.

1. Introduction

Competition horses endure a variety of stressors including adjusting to new environments, high athletic demands, limited turnout, and traveling. It has been previously demonstrated that trailering a horse can initiate a stress response. Fazio et al. [1] found that there were statistically significant differences in blood cortisol levels before and after trailer rides. If horses have not adjusted to high stress levels or experience a greater degree of stress-related symptoms at international competitions, there are limited legal medications available that could help these horses based on the controlled and prohibited medications list from the Federation Equestre Internationale [2]; lavender, when inhaled through the air, is not an illegal substance according to the United States Equestrian Federation [3]. Ferguson et al. [4] examined the effects of lavender aromatherapy in horses and found no statistical difference in respiratory rate, but a difference in heart rates (HRs) was determined to be statistically significant. In this study, we examined the effects of lavender aromatherapy on the stress response of horses.

Horses are obligate nasal breathers, with specific olfactory receptors located in the nasal cavity where chemical components bind and cause a G-protein coupled receptor cascade. If this cascade sufficiently depolarizes the olfactory neuron, an action potential will propagate down the axon of the afferent olfactory neuron, which passes through the cribriform plate and enters the olfactory bulb of the central nervous system [5]. The signal will be transmitted through various sections of the brain including the limbic system, which is responsible for interpreting primary emotions such as stress and fear.

As a horse encounters a stressor, the signals are processed in the brain and cause a reaction by propagating signals through the limbic system. The neurosecretory cells of the hypothalamic periventricular nucleus will secrete neurotransmitters and

Animal welfare/ethical statement: The protocols used in this study to obtain equine blood samples and heart rates and quantify data were reviewed and approved by the Institutional Animal Care and Use Committee at Albion College. The horse's safety and health were a priority.

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* Corresponding author at: Kylie Heitman, Department of Science, Albion College, 611 E. Porter St, Albion, MI 49224.

E-mail address: krh16@albion.edu (K. Heitman).

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neuropeptides at the median eminence, which cause the release of corticotropin-releasing hormone (CRH) into the bloodstream [6]. CRH bind to receptors on corticotropic cells on the anterior pituitary gland causing the release of proopiomelanocortin (POMC). POMC gives rise to adrenocorticotropic hormone, which diffuses into the portal vein of the anterior pituitary, travels through the superior and medial suprarenal arteries of the adrenal gland, and binds to the melanocortin-2 receptor. This binding event causes cortisol to be secreted from the adrenal cortex and into the bloodstream [7,8]. Up to this point, no previous reports have studied cortisol levels in horses treated with any form of essential oil.

Cortisol is involved in a wide variety of cellular functions, including immunological, metabolic, muscular, bone development, and blood pressure (BP). Cortisol's main function during a stress response is to redirect energy to organ systems that will allow the organism to survive. Cortisol will freely permeate across the cell membrane, bind to its receptor, and act as a transcription factor. In skeletal muscle cells, cortisol's main function is to increase levels of blood glucose by repressing insulin and altering glycogen, protein, and fatty acid synthesis. Treating rats via intravenous injection of glucocorticoid receptors resulted in significant muscle cell atrophy [9].

Too much circulating cortisol for prolonged periods of time can have a negative impact on the well-being of the animal as it can increase blood glucose levels, vasoconstrict arteries, and modulate the immune response. Issues such as cardiovascular and autoimmune diseases and gastrointestinal, fertility, and sleep disorders can result in prolonged, chronic stress [10]. Therefore, it is important to reduce unnecessary chronic stress levels in horses.

Competition horses are susceptible to a variety of unnecessary stressors. These stress-related biomolecules could have a negative impact on a horse's immune system, metabolism, and performance; therefore, it should be a shared goal to reduce these unnecessary stressors to optimize the quality of life for the animal. Lavender aromatherapy has the potential to reduce stress levels based on previous studies. Although little is known on how lavender aromatherapy can suppress equine stress, there is supportive evidence in other species. We hypothesize that lavender aromatherapy has positive effects on helping horses cope with stress. We predict that these effects can be measured in lowered HR and cortisol levels in horses that have been subjected to lavender aromatherapy during a stressor.

2. Materials and Methods

Seven castrated male horses and one female horse were used in this crossover study. Each horse was exposed to both control and experimental treatments. The horses ranged in age from 8 to 21 years and had previous experience in trailering. The breeds of the horses included Thoroughbreds, Warmbloods, Quarter horses, Arabians, and Morgan-cross horses. Before using the horses, the procedure was approved by the Institutional Animal Care and Use Committee at Albion College; the safety and health of the animal was a priority among the handler and veterinarian.

The baseline HRs and blood samples were taken on each of the eight horses before loading in pairs onto a 1.95 m × 2.88 m two-horse Sundowner 777 Sunlite bumper pull horse trailer. HRs were taken from behind the left elbow using a stethoscope for 30 seconds, and blood samples were taken through the jugular vein utilizing Vacutainer brand collection needles and BD Vacutainer serum separator tubes. A licensed veterinarian collected blood samples, and a handler took HRs. Horses #1–4 were randomly assigned as the treatment group and received a 20% lavender oil, 80% distilled water aromatherapy treatment using lavender (product #3575) from Young Living Essential Oil administered by a diffuser (product #058321) from Spa Room, which works by vaporizing liquid. Horses #5–8 were used as the control group and received a distilled water aromatherapy treatment in the same diffuser. The amount of liquid in the diffuser was filled to the diffusers capacity of 118 mL and refilled after each trailer ride. Once the paired horses were loaded in the trailer, the diffuser was activated and remained activated for the duration of the trailer ride. The control horses were trailered first to prevent any possible responses to leftover scents. All air vents and windows remained closed to insulate the scent. All eight horses were trailered in groups of two for 15 minutes of driving 5.5 miles over even terrain with five turns.

The trailer ride served as the stressor allowing cortisol levels and HRs to increase. Immediately after the ride, the second collection of HRs and blood samples was made. The third collection of HRs and blood samples was made 50 minutes after the trailer ride. Blood samples were centrifuged in a Hamilton Bell VanGuard V6500 centrifuge at 3,437 rpm for between 5 and 7 minutes at room temperature allowing for the separation and isolation of serum, after which, the serum was frozen at −32°C until further quantifications were made.

For the crossover experiment, the same eight horses were trailered in the same pairs as before, following the same route previously described, in the same horse trailer. This second set of data was taken 4 weeks from the first set of data. Horses #1–4 were used as the control and received a distilled water aromatherapy treatment, and horses #5–8 were used as the treatment group and received lavender-water mix. The same diffuser was cleaned according to product directions and run with three separate water washes to ensure complete removal of residual lavender oil.

A cortisol ELISA kit (ADI-900-071; Enzo Life Sciences; manufactured in Ann Arbor, MI. U.S.A) was used to quantify cortisol levels. Sample preparation involved three separate 200-μL diethyl ether extractions followed by drying under nitrogen. All data analyses were performed using Excel. T-tests performed on the averaged raw data were one-tailed homoscedastic t-tests, whereas those performed on the stressed minus baseline values utilized the one-tail paired *t*-test. All significance values were calculated at the 5% level.

3. Results

3.1. Raw Results

The differences for average HR between baseline and stressed and stressed and recovery were statistically significant. The differences for average cortisol between baseline and stressed were statistically significant. A more complete outline can be found in the Supplementary Material section.

3.2. Statistical Analysis

Individual baseline values were subtracted from individual stressed values for both control and treatment horses, as baseline values varied from individual horses between crossover measurements. The average increased HR for the control horses was 10.6 b/m (±2.6 standard error [SE]); the average increased HR for the treatment horses was 9.3 b/m (±2.6 SE) (Fig. 1). These values were not significant ($t = 1.9$, $P = .37$, $df = 7$).

The average increase in cortisol for the control horses (3,747.2 pg/uL ± 864.2 SE) was significantly greater than the average increase in cortisol for the treatment horses (2,511.8 pg/uL ± 1009.9 SE) ($t = 1.9$, $P = .037$, $df = 7$) (Fig. 2).

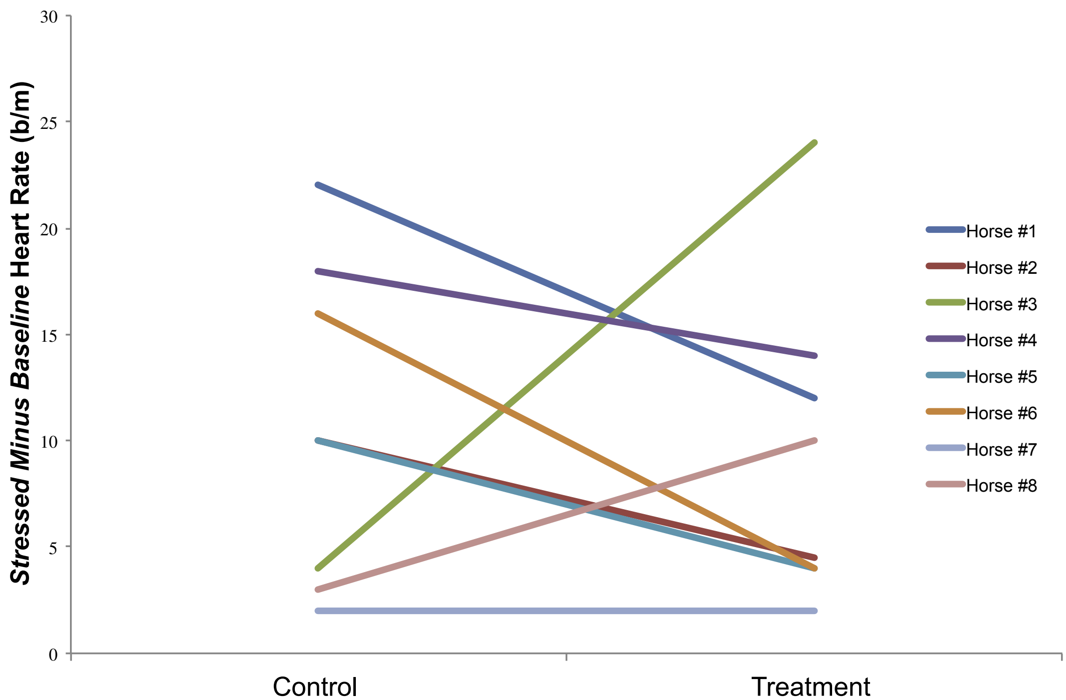

Fig. 1. Stressed minus baseline heart rates for individual control and treatment horses. Statistical significance was generated utilizing a one-tailed paired *t*-test (*P*-value = .37).

The average change in HR between the stressed and recovery measurement for the control horses was −12.25 b/m (±3.95 SE), and the change of HR for the treatment horses was 9.5 (±3.5 SE). These values were not statistically significant ($P = .32$) (Table 1).

The average change in cortisol between the stressed and recovery measurement for the control horses was −3,066.6 (±782.9 SE), and the change in cortisol for the treatment horses was −1,961.9 (±697.9 SE). These values were statistically significant ($P = .047$) (Table 1).

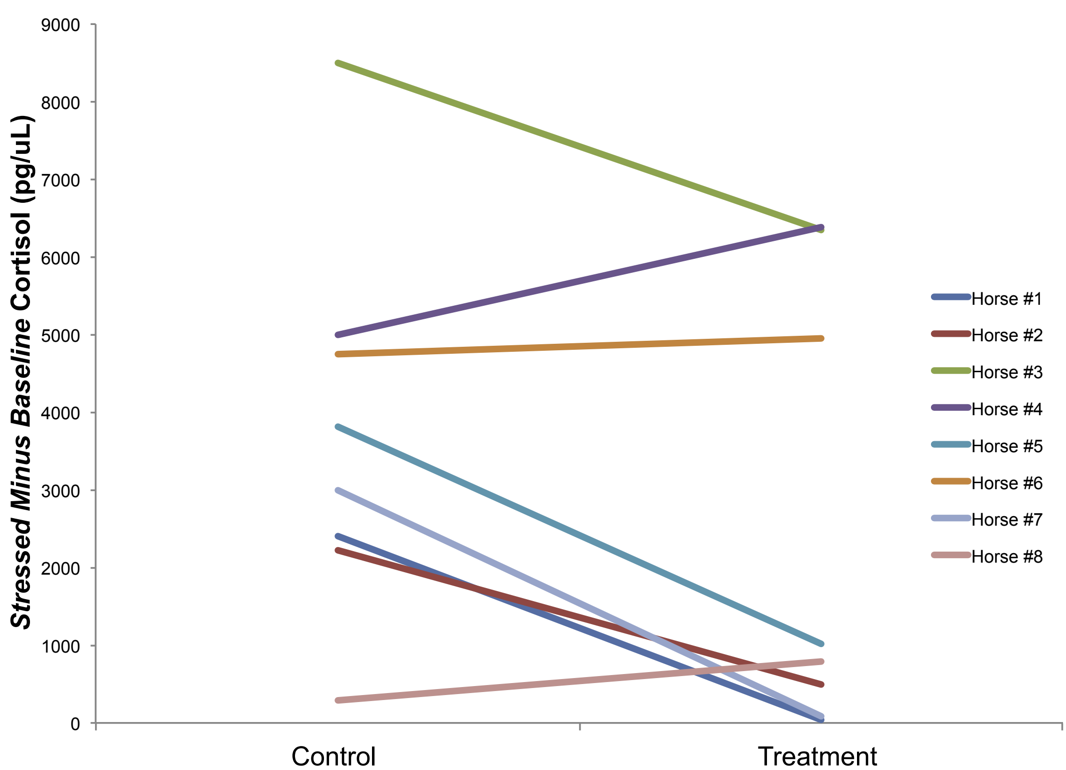

Fig. 2. Stressed minus baseline cortisol levels for individual control and treatment horse. Statistical significance was generated utilizing a one-tailed paired *t*-test (*P*-value = .037).

Table 1
Average stressed minus baseline and recovery minus stressed parameters for heart rate (HR) in beats per minute (b/m) and cortisol (pg/ul) in both the control and treatment trailer rides.

Aromatherapy Group	Mean ± SE Δ in HR (b/m) (Stressed−Baseline)	Mean ± SE Δ in HR (b/m) (Recovery−Stressed)	Mean ± SE Δ in Cortisol (pg/uL) (Stressed−Baseline)	Mean ± SE Δ in Cortisol (pg/uL) (Recovery−Stressed)
Water control	10.624 ± 2.6[a]	−12.25 ± 3.95[c]	3,747.2 ± 864.2[e]	−3,066.6 ± 782.9[g]
Lavender treatment	9.3125 ± 2.6[b]	−9.5 ± 3.5[d]	2,511.8 ± 1009.9[f]	−1,961.9 ± 697.9[h]

Abbreviation: SE, standard error.
[a,b] Values within the column with different superscripts are not different ($P = .37$).
[c,d] Values within the column with different superscripts are not different ($P = .32$).
[e,f] Values within the column with different superscripts are different ($P = .037$).
[g,h] Values within the column with different superscripts are different ($P = .046$).

4. Discussion

Both the control and treatment horses showed significant increases in average HR and serum cortisol levels when trailered, indicating that trailering is a form of stress on the animals. In addition, average stressed HR was significantly higher than average recovery HR for both the control and treatment groups, indicating that HR decreased once the horse was removed from the stressor. With regards to cortisol, control horses showed significantly higher levels when stressed than then in recovery, but there was no significant difference found among the treatment horses between stressed and recovery states. Finally, there was no statistical difference between the baseline HRs and cortisol levels for both the control and treatment groups, indicating that the horses' HRs and cortisol levels did not differ between crossover measurements.

The stressed minus baseline values do not show a statistically significant difference between average HRs for the control and treatment groups meaning that the lavender aromatherapy did not cause a significant difference in HR ($P = .37$). However, results of cortisol levels suggest that such levels were suppressed in horses when they received the lavender aromatherapy. Differences in statistical findings between HR and cortisol could be contributed to HRs ability to alter more quickly than circulating cortisol. For future studies, a more accurate analysis of HR should be done with an equine HR monitor.

Though there is limited research in this field as it relates to horses, it is appropriate to discuss findings in other species. Previous reports found that oregano essential oil and major chemical components of lauraceae EO (a kind of essential oil) can decrease blood cortisol levels in pigs following transportation stress, and fish when subjected to stress [11,12]. When administering lavender to groups of nervous and calm sheep, Hawken and Blache [13] found that lavender significantly reduced cortisol levels throughout a 30-minute time interval in calm sheep, but increased cortisol in the group of nervous sheep. The lavender oil reduced movement and vocalization frequencies in predetermined calm sheep with low baseline cortisol concentrations. In the treatment group of nervous sheep which received lavender, movement, vocalization frequency, and cortisol concentrations increased after 30 minutes compared with the control group of nervous sheep. These results suggest genetic differences in behavior that can change the effectiveness lavender has on the animal. Therefore, it may be nessisary to consider the emothion state of the animal before using lavender to reduce stress [13].

In addition to cortisol repression by lavender aromatherapy, there is evidence of HR repression correlated with lavender aromatherapy. Using a combination of light therapy and three different scents of aromatherapy (lemon, peppermint, and lavender) on humans, Dong and Jacob [14] found that HR and BP decreased in patients, though the greatest decrease in the HR and BP occurred when lemon aromatherapy was used in conjunction with light therapy.

5. Conclusion

Overall, our results show that cortisol levels were suppressed in stressed horses that received lavender aromatherapy. These conclusions partially support the original hypothesis that lavender aromatherapy has positive effects on horses during a stressful situation. Cortisol was the only parameter that was lowered in horses that were subjected to lavender aromatherapy during a stressor. Follow-up studies should include additional stress biomarkers, different essential oils, and examine how aromatherapy can affect baseline values without a stressor.

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Supplementary Data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jevs.2017.12.008.

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