Torsten Hohmann, Peter Kreimeier and Franz-Josef Bockisch, Brunswick, with Willa Bohnet, Hanover

Effects of different concentrate feeding techniques for horses in single loose box stabling

With manual concentrate feeding in single loose boxes horses often become agitated and thus susceptible to injuries and stress because they do not receive their feed simultaneously. To evaluate stress caused by different feeding techniques, behavioural analysis during feeding was integrated with analysis of heart frequency variability (HRV). Signs of stress were identified during the period horses had to wait to get their rations after feeding had commenced. This stress increased the longer the waiting period continued.

In loose box systems occupied by single horses concentrates are fed two to three times daily. In most cases such feeding is conducted manually in spacious stables with large numbers of single loose boxes and with rations having to be carried some distance. The result can be relatively long waiting times before some animals get their feed with horses reacting differently according to the length of waiting time.

The aim of these investigations is to identify ways of improving concentrate feeding techniques through the methods described below.

Behavioural analysis was integrated with heart frequency variability analysis for quantifying possible stress. Heart frequency variability analysis is a non-invasive and objective method for measuring stress or perceived stress with animals both qualitatively and quantitatively and which delivers an indirect indication of sympathovagal balance with vagustonus serving as stress indicator. The parameter "high frequency power" in heart frequency analysis reflects the vagustonus.

Video recorded horse behaviour could then be matched with vagustonus readings.

Heart frequency measuring equipment for horses from Polar (Polar Equine S810i) was used, the equipment attached on standard elastic blanket belts (*Fig. 1*).

Midday and evening feeding was digitally recorded and saved.

Through the heart frequency measuring instrument all interbeat intervals (IBIs) were recorded with ECG accuracy. The IBIs served as calculation basis for the following HRV mathematical parameter: the frequency analysis parameter (Task Force of the European Society of Cardiology and the North American Society of Pacing Electrophysiology [1]):

- LF power (low frequency power)
- HF power (high frequency power); Unit: normalized units [n.u.] (Percentage proportion of HF power in total power without consideration of very low frequency power).

The LF power reflects sympathetic, as well as parasympathetic, activities whereas the HF power only records parasympatheticus, in other words increased HF power indicates an increased vagustonus [2]. A reduced vagustonus is an expression of physical or psychological stress [3].

Video monitoring filmed behavioural reactions during concentrate feeding (pawing, walking about in the loose box or threatening behaviour) and these were compared with the respective heart frequency variability analyses. The software "Interact Version 7" (Mangold Software) was applied for quantitative and qualitative evaluation of the video recordings.

Fig. 1: Attaching of the measuring instruments (type polar Equine S810i) for recording heart frequency variability

Veterinary surgeon Torsten Hohmann is studying for his doctorate at the Institute of Production Engineering and Building Research, FAL. Dipl.-Ing. agr. Peter Kreimeier is a scientific technician there. (Director: Prof. Dr. habil. Franz-Josef Bockisch), Bundesallee 50, 38116 Brunswick; e-mail: *peter.kreimeier@fal.de*
The project was conducted with the assistance of Dr. Willa Bohnet from the Institute of Animal Welfare and Behaviour, Animal Welfare Centre, Veterinary University Hanover.

Keywords

Horse husbandry, concentrate feed handling, stress load

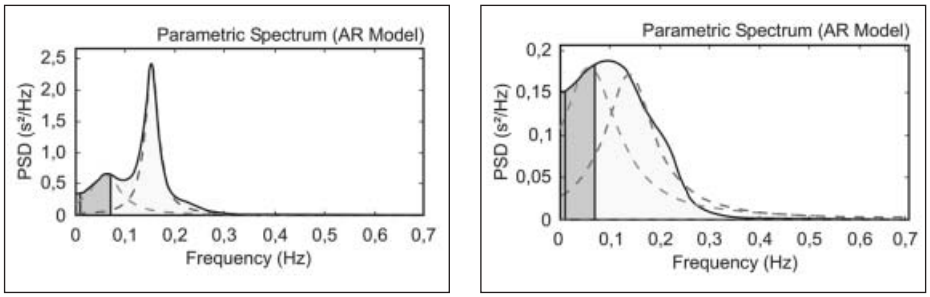

Fig. 2: PSD (Power Spectral Density) versus heart rate for delayed (left) and direct concentrate handling (right) for a 2 years light horse mare

The experiment structure

featured three variants. In the first, horses were fed their concentrates simultaneously 10 times daily via time-controlled automatic feeders (manufacturer Weinsberger). The second variant differed from the first only in that feeding was thrice daily. In the third variant concentrate feeding was carried out manually by stable staff as in most practical situations. The sort of time lag experienced with loose box housing and long stable passages was simulated by staggering feeding times with the first horse in the trial stable getting feed immediately, the following horses having to wait 0.5, 1.0, 1.5, 2.0 and 2.5 minutes respectively before getting theirs.

Behavioural analyses indicated very little difference between horses in the first two variants. In the third variant, behavioural reactions increased in line with waiting time length. Most common behavioural symptoms included obstinacy, pawing , threatening behaviour, head tossing and box pacing and were possibly ways of dealing with the stress of waiting.

Through HRV analysis, significant differences of LF/HF power distribution during the different feeding situations were observed (*Fig. 2*).

In the first variant the heart frequency average value was lower, and the value of the heart frequency variability analysis (the HF power) higher reflecting a lower stress load than the second variant (*Fig. 3*). In the third variant the average of the heart frequency rose in line with the increasing length of waiting period whereby the HF power reduced during a minute's waiting period before starting to rise slightly.

The increased heart frequency readings as well as the behavioural analyses and the reduced HF power reading all indicated increased stress for the trial horses through having to wait before being fed their concentrates manually (variation 3).

With the automatic concentrate feeding (variants 1 and 2) the ten times daily routine appeared to be less stressful.

Discussion and conclusions

Up until now, a large number of experiments have been carried out around automized feeding of horses. However these concentrated mainly on the practicability of the feeding systems with associated behavioural recording mainly of horses kept in groups. Himstedt and Bosler [4] noted that following introduction of concentrate feeding automatics in their horse clinic, the resultant continually repeated routine of feeding led to increased calmness in the stable as well as reduction in the much-feared factor of illness developing during a clinic stay.

With conventional behavioural analyses it is very difficult to evaluate stress effects on horses. One way to determine possible stresses during waiting times associated with traditional manual concentrate feeding, and offering the advantages of objectivity and non-invasiveness, is analysis of heart frequency variability.

Own results from HRV and behavioural analysis do not differ significantly where the trial horse is fed simultaneously with its stable companions via automized or hand feeding. If, however, the horse has to wait after the beginning of the feeding in the stable for its ration this then results in a reduction in parasympathetic activity.

The reduced vagustonus indicates a not-to-be-underestimated stress load, especially when it is considered that the a horse stays for many years in the same box and, day-in day-out, has to wait always for its concentrate feed. This can increase the disease susceptibility of the horse and thus negatively affect performance capabilities.

Automatic and simultaneous concentrate feeding several times a day thus represents an improvement for healthy horse-keeping conditions in single loose box systems.

Literature

[1] Task Force of the European Society of Cardiology and the North American Society of Pacing Electrophysiology: Heart Rate Variability. Circulation , 1996, pp. 1043-1065

[2] *Kuwahara, M., S. Hashimoto, K. Ishii, Y. Yagi, T. Hada, A. Hiraga, M. Kai, K. Kubo, H. Oki, H. Tsubone and S. Sugano* : Assessment of autonomic nervous function by power spectral analysis of heart rate variability in the horse. J Auton Nerv Syst. 60 (1996), no. 1-2, pp. 43-48

[3] *Porges, S. W.*: Cardiac vagal tone: a physiological index of stress. NeuroSci Biobehav Rev 19 (1995), no. 2, pp. 225-233

[4] *Himstedt, R., und K. Bosler* : Neuartige Futterautomaten für Pferde. Veterinär- Spiegel (1992), H. 4, S. 58-59

[5] *Pagani, M., O. Rimoldi, P. Pizzinelli, R. Furlan, W. Crivellaro, D. Liberati, S. Cerutti and A. Malliani* : Assessment of the neural control of the circulation during psychological stress. J Auton Nerv Syst. 35 (1995), no. 1, pp. 33-41

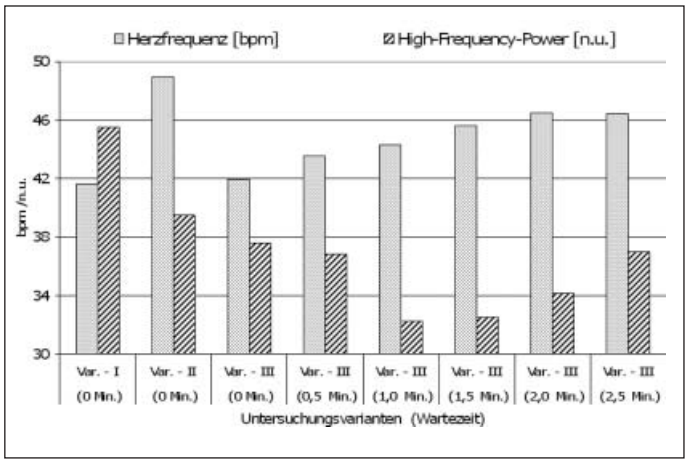

Fig.3: Heart rate and high-frequency-power of the variants investigated