Development of a sensor-based automated measurement system for monitoring chewing and animal activity in horses

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Introduction: In modern husbandry of domestic horses, feeding conditions contribute highly to animal health and welfare. Therefore, chewing and animal activity are suitable parameters for monitoring health, nutritional and behavioural conditions of horses. The aim of this study is to develop an automated measurement system to generate empiric data. Most previous studies concerning feed intake and chewing activity were based on visual observations only. With the development of an automated measurement system for horses it will be possible to record quantitative data. The RumiWatch system (Itin+Hoch GmbH, Liestal, Switzerland), containing a noseband pressure sensor as well as a pedometer for recording animal activity, is already an established research tool for cows (NYDEGGER et. al 2011, ZEHNER et al. 2012). This study aims to modify the system in order to be able to measure chewing and animal activity in horses. The advantage of this research tool is that it will give us the novel opportunity to collect continuous data on chewing behaviour in horses over long periods of time.

Material and methods: Ten horses (5 stallions, 5 mares; 8 Freiberger, 2 Swiss Warmblood; aged 8 to 17 years; body mass 601 ± 38 kg) were included in the study. The horses were stabled individually on straw bedding. They were fed forage (hay; haylage) and concentrates twice daily and exercised regularly (riding, driving and other activities). In addition to the RumiWatch recordings, the horses were observed visually during feeding. During the observation periods, chews were counted manually on a tablet computer in Microsoft Excel sheets. The recorded chews were linked to time stamps and behavioural categories. The observations were split into 10-minute intervals. We collected data from 6 intervals per feed and horse in total; 3 intervals in the morning and 3 intervals in the evening over 3 different days. For statistical analysis a paired t-test was conducted with the statistical software SPSS (Version 22, IBM Corporation, Armonk, USA).

Table 1: Experimental design for direct observations from feeding periods with various feeds.

Trial	Feed	Horses [n]	Observation period (per horse/day)	Duration per horse
1	hay + concentrate	5 mares	hay: 2 x 10 min concentrate: 2 x 5 min	3 different days in the morning and evening
2	haylage + concentrate	5 mares	haylage: 2 x 10 min concentrate: 2 x 5 min	3 different days in the morning and evening
3	hay + concentrate	5 stallions	hay: 2 x 10 min concentrate: 2 x 5 min	3 different days in the morning and evening
4	haylage + concentrate	5 stallions	haylage: 2 x 10 min concentrate: 2 x 5 min	3 different days in the morning and evening

Results: The device is able to generate consistent measurements of chewing activity in horses. An exemplary recording sequence of the noseband sensor is shown in Figure 1.

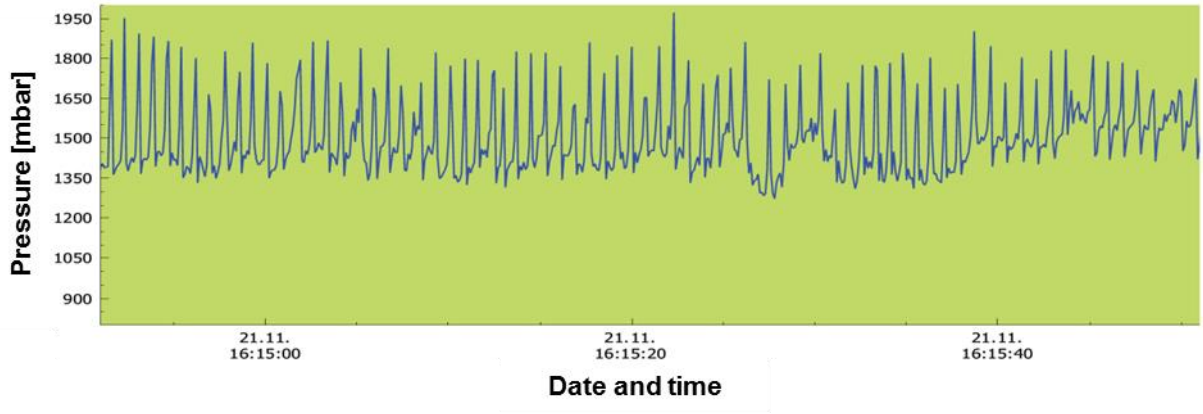

Figure 1: Pressure signals of horses' chewing activity of hay recorded with the RumiWatch noseband sensor.

Preliminary data analysis has shown that the collected data of chews revealed a mean deviation between visual observation and automated recordings of approximately 7%. The mean of chews per minute between visual and automated measurement were significantly different in all horses (hay p = 0.001; haylage p = 0.023; concentrate p = 0.001).

Discussion: During data acquisition, specific differences between chewing activity and various feed types occurred. These results concur with a study of BONIN et. al (2007). The higher values collected by the automatic measurement system showed a great sensitivity. Further jaw movements were recognized as chews which were not visually counted as such. This might have been caused by licking, biting or other activities. Additionally, the software package classified various periods of feeding as rumination. The RumiWatch system can be well adapted to horses, if all these aspects are considered. The advantage to other automatic measurement systems (e.g. electromyographic evaluation of masseter muscle activity, VERVUERT et al. 2012) is the practical integration in a conventional horse halter and, thus, resulting in a useful measurement tool.

References

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