

The Importance of Natural Feeding Behaviour for Horse (*Equus caballus*) Welfare

Sandra Brolin

Examiner, Lina Roth
Supervisor, Per Jensen

Contents

1	Abstract	1
2	Introduction.....	1
2.1	Aim	2
3	Materials and Methods.....	2
4	Horse management can influence behaviour	3
4.1	How horses are kept	3
4.2	Stereotypies	4
4.3	Oral stereotypies	4
4.4	Difficulties with already established stereotypic behaviour.....	6
4.5	Pasture time can increase horse welfare	6
5	Natural feeding behaviour are not always possible	7
6	Adopting alternative feeding methods to improve horse welfare	8
6.1	Alternative feeding methods.....	8
6.2	Slow feeders	9
7	Conclusions.....	12
8	Societal & ethical considerations.....	12
9	Acknowledgements.....	12
10	References.....	13

1 Abstract

Horses are herbivores and can graze for up to 20 hours per day. It is well known that animals are motivated to perform natural behaviours and horses have, except from a physiological need to graze, a strong motivation to perform their natural feeding behaviour. This review aimed to give insight into how horses are kept, how the way they are kept affects their behaviour and welfare, if there are reasons why some horses cannot be kept on pasture, and if alternative feeding strategies can improve horse welfare by allowing horses to perform their natural feeding behaviour. Most horses are kept in stables and are put on feeding regimes that do not resemble their natural feeding behaviour. This can lead to development of stereotypies, and when prevented from carrying out their feeding behaviour, oral stereotypies such as crib-biting can result. Horses kept free range display very few, if any, stereotypies and is therefore the best way to keep horses from a welfare approach. However, obesity and grass-related illnesses can restrict horses from being kept on pasture, thus, alternative feeding methods for stabled horses is imperative. Use of edible bedding, presenting several types of forage, providing *ad libitum* forage, or using slow feeders are alternative methods that could be implemented by horse owners and caretakers to improve horse welfare. Horses can however respond differently to these methods and a method that suits one horse might not be appropriate for another.

Keywords: Animal welfare, Feeding methods, Horse feeding behaviour, Stereotypies, Slow feeder, Stabled.

2 Introduction

Horses of the family Equidae are herbivores (Giles et al., 2020; Sarrafchi & Blokhuis, 2013; Thorne et al., 2005) that evolved 20 million years ago from being browsers eating foliage, to being grazers feeding mainly on grass (Semperebon et al., 2016). However, horses, *Equus caballus*, living today has been seen consuming a mixed variety of plants, including foliage (Sarrafchi & Blokhuis, 2013; Thorne et al., 2005). Because horses are prey, they gain security from being social animals (Cameron et al., 2021; Leme et al., 2014; Sarrafchi & Blokhuis, 2013), and the bonds of the herd are strengthened by interactions such as grooming and sharing of food (Sarrafchi & Blokhuis, 2013). In these groups, horses can travel great distances to find food and shelter, and most of their movement occur at a slow pace while they are continuously grazing (Giles et al., 2020; Lesimple et al., 2020; Sarrafchi & Blokhuis, 2013). The largest part

of the time budget for horses in natural conditions is spent on grazing and is a way to compensate for the low energy of the food the horse consume (Ellis, Redgate, et al., 2015; Sarrafchi & Blokhuis, 2013; Thorne et al., 2005). Furthermore, horses recover a great deal of calories from fermentation occurring in the intestines and to regulate fermentation, a high fibre content is required (Sarrafchi & Blokhuis, 2013).

Horses has, since they were domesticated, historically been used in warfare, been sold or traded for other goods, been an aid in agriculture, and has been used as a way of transportation (Sempredon et al., 2016). Today, horses are mainly kept for competition and recreational purposes (Leme et al., 2014). However, whatever the reason for keeping domesticated animals, humans have a responsibility to care for the animals they keep, and an important key of animal welfare is the ability to perform natural behaviours (Ruet et al., 2020). For horses, that spend up to 20 hours per day grazing (Sarrafchi & Blokhuis, 2013), the feeding behaviour is highly motivated. Horses that are kept free range lives in groups outside with the ability to graze, and they can be kept free range for part of the day, or for the full day. However, horses that are kept in ways that prohibit them from grazing and have feeding regimes that do not let them perform their feeding behaviour, can develop abnormal behaviour such as stereotypies, which is associated to poor welfare (Sarrafchi & Blokhuis, 2013). Thus, it is important to find alternative feeding strategies that allow the horse to perform its natural feeding behaviour, even when it is not possible to keep them in a natural environment.

2.1 Aim

The aim of this study was to investigate how horses are kept, and the effects on welfare that results when preventing horses from performing their natural feeding behaviour. Furthermore, I wanted to see if there are reasons why some horses cannot be kept in a way that allow them to perform their feeding behaviour. Lastly, I wanted to investigate if horse welfare could be improved by implementing alternative feeding methods that allow the horse to feed in a way that more resemble its natural feeding behaviour.

3 Materials and Methods

The search engine UniSearch, offered by Linköping university library, was used to find relevant literature to achieve the aim with this study. The search was limited to articles provided in

English, and to academic journals that provide peer-reviewed literature. No limitation was set for year since both evolutionary and research history for horse welfare was of interest. In some cases, literature was retrieved from references used in other articles found through UniSearch, if they were of relevance.

The words and phrases used in the search engine to find relevant literature was; "Horse feeding behaviour", "Horse feeding history", "Horse stereotypies", "Horse natural behaviour", "Stabled horses", "Free range horse", "Slow feeder horse", "Laminitis grazing".

4 Horse management can influence behaviour

4.1 How horses are kept

Keeping horses stabled is convenient for humans since it allows for easier handling, care, and control of feeding (Leme et al., 2014; McGreevy, 1997) and horses kept for competitive and commercial reasons can be stabled for more than 20 hours per day (Lesimple et al., 2019). Leme et al. (2014) performed a questionnaire study on how horses were kept in Brazil. The data was collected on horses kept for competition, commercial and recreational purposes and they found that the majority of all horses are primarily housed in individual boxes, with only 10% of the horses being kept fully free range (Leme et al., 2014). The horses that were stabled spent at least 12 hours in their stall, but some horses were kept in their stall for up to 24 hours (Leme et al., 2014). Another study on horses in Malaysia showed that horses, apart from being taken out for exercise or work, were kept in individual boxes all day (Hanis et al., 2020b). However, a survey study on 17,248 horses in Nordic countries, performed by Hartmann et al. (2015), found that almost 47% of the horses, instead of being stabled, were kept in groups 24 hours per day and approximately 45% of the horses were kept with other horses during the day but was individually stabled by night.

The result from the study on Nordic horses differ considerably from the study on horses in Brazil and Malaysia, but there may be a chance that the results are misleading. Participation in the study on Nordic horses were voluntary for the horse owners and there might therefore be an overrepresentation of horse owners positive towards keeping horses in groups rather than stabled (Hartmann et al., 2015). However, it could also be that Nordic countries has laws that promotes animal welfare. In Sweden for example, there is an animal welfare law which states

that animals must be kept in a way that promote welfare, allow animals to carry out natural behaviours, and prevent development of abnormal behaviour (Djurskyddslag 2018:1192). There are also horse specific regulations stating horses must be allowed to move freely outside on a daily basis, unless there are special circumstances such as injuries (Jordbruksverket, 2022). The reason as to why some of the Nordic horses are stabled during night may be because they do not have an open shed to take cover in, which they must have if they are kept outside for more than 16 hours during winter, according to Swedish regulations (Jordbruksverket, 2022).

4.2 Stereotypies

By keeping horses stabled, limitations are set on the ability to perform their natural feeding behaviour (McGreevy, 1997) and animals not able to carry out their natural behaviours can suffer from poor welfare (Ruet et al., 2020). The importance of animal welfare has been recognised the last decades, not only by the public and animal caretakers, but also among scientists (Hanis et al., 2020a). This has led to research on what affects the welfare of horses, and how their welfare can be improved.

A suitable indicator of animal welfare is behaviour since it can be used for early detection of poor welfare (Sarrafchi & Blokhuis, 2013). Stereotypies is one type of behavioural indicator used in studies observing animal welfare. Stereotypies are abnormal repetitive behaviour that has no apparent function but might help horses cope with unnatural conditions (Albright et al., 2017; Lesimple et al., 2019; McGreevy, 1997; Sarrafchi & Blokhuis, 2013; Whisher et al., 2011) and the form of stereotypy could be the result of the animal not being able to perform one of their natural behaviours (Lesimple et al., 2019).

4.3 Oral stereotypies

One group of stereotypies that has received attention among researchers are oral stereotypies where crib-biting, wind sucking, and licking are most commonly reported (Hanis et al., 2020a, 2020b). Crib-biting, also called cribbing, is when the horse grasps an object with its incisor teeth and while flexing its ventral neck muscles, draws air into its oesophagus (Albright et al., 2017; McGreevy, 1997; Sarrafchi & Blokhuis, 2013; Whisher et al., 2011). Wind sucking is very similar to crib-biting, but without the horse grasping an object with its incisor teeth (Hanis et al., 2020b). Licking is performed repetitively on inanimate objects (Hanis et al., 2020b).

Oral stereotypies are affected by feeding practices such as how many times per day a horse is fed and has been linked to frustration due to not having enough access to food (Hanis et al., 2020a). Searching for food and grazing is taking up 12 to 20 hours of a horse's time budget when they live in such conditions where they have the possibility to perform their natural feeding behaviour (Baumgartner et al., 2020; McGreevy, 1997; Sarrafchi & Blokhuis, 2013). But since most horses are kept in unnatural environments such as stables, they do not have the possibility to feed in a natural manner and substantially less time can be allocated to feeding. Often roughage such as hay are also replaced by concentrated feed, and hay is only fed in small amounts once or twice a day (Hanis et al., 2020b; McGreevy, 1997). This limits horses from performing their natural feeding behaviour even further.

For horses in Malaysia that were given a small amount of hay per day (2 – 3 kg), the prevalence of oral stereotypies was at almost 38% compared to 16% in horses being fed more hay (4 – 8 kg; Hanis et al., 2020b). The prevalence of oral stereotypies also varied with the amount of concentrate fed to horses. Horses that were fed 4 to 6 kg of concentrate had a prevalence for oral stereotypies of almost double (35%) of what horses fed 2 to 3 kg had (18%). However, horses fed 7 to 9 kg of concentrate had a much lower prevalence of stereotypies (1%) (Hanis et al., 2020b). This demonstrates that the way we feed horses has an effect on their behaviour (Hanis et al., 2020b).

Although the study by Hanis et al. (2020b) showed that high amounts of concentrated feed led to a low prevalence of oral stereotypies there might be other aspects of the horse's welfare that are affected (Rochais et al., 2018). Thus, the type and amount of feed must be considered when creating feeding regimes for horses. Furthermore, concentrated feed has been shown to induce crib-biting in horses while the tendency to crib-bite is reduced for horses that are allowed to consume hay (Albright et al., 2017).

Crib-biting has been associated with diet and gastrointestinal function (McGreevy, 1997; Whisher et al., 2011) and according to contemporary studies, crib-biting is mainly caused by problems with the gastrointestinal system and how the horse is fed (Hanis et al., 2020a). Considering concentrated feed has been shown to induce crib-biting, this suggests that feeding the horse concentrate can have a negative effect on the gastrointestinal system of the horse.

4.4 Difficulties with already established stereotypic behaviour

Stereotypies such as crib-biting can be difficult, if not impossible, to get rid of and it is therefore important to stop stereotypies from emerging (Sarrafchi & Blokhuis, 2013). Whisher et al. (2011) performed a study where they looked at how environmental effects such as exercise, different types of concentrate (sweetened grain or oats), and toys that the horses could interact with and either lick or eat from, impacts cribbing activity. The horses were kept stabled apart from 30 to 60 minutes in a paddock with no grass and even though all horses were provided *ad libitum* hay, crib-biting had become a habit for all horses participating in the study (Whisher et al., 2011).

To test if exercise had an effect on cribbing, the horses were lunged in an indoor round pen for a period of 8 weeks beginning with 10 minutes, and then increasing to 15, and lastly 20 minutes of canter (Whisher et al., 2011). The results from the exercise revealed that the crib-biting rate decreased only slightly for the 15-minute cantering period, and increased for both the 10- and 20-minute cantering period (Whisher et al., 2011). The results could have been affected by the horses being exercised indoor and only allowed to move in a circle for a long period of time, and other kinds of exercise might have been perceived as more enriching by the horse, leading to different results (Whisher et al., 2011). When Whisher et al. (2011) compared sweet tasting concentrated feed with oats, they saw that the cribbing rate was lower for horses fed oats (15.5% of day) compared to those fed sweetened grain (27% of day), thus, looking over the type of concentrate given could have positive effects for horses with cribbing behaviour. The toys used for the study took up a maximum of 5% of the daily time budget for the horses and only the sweet tasting toy that the horses could lick had a positive effect on cribbing behaviour (Whisher et al., 2011). Considering sweet tasting concentrated feed increased crib-biting, but licking of the sweet tasting toy did not, suggests that it is only after ingestion that sweet substances induce crib-biting (Whisher et al., 2011). This study demonstrate that feeding is what has the largest effect on cribbing behaviour for horses with an already established pattern of crib-biting. However, Cribbing did not cease completely for any of the horses which displays the importance of stopping stereotypies before they emerge.

4.5 Pasture time can increase horse welfare

None of the horses in the study by Whisher et al. (2011) were allowed to perform their natural feeding behaviour. Ruet et al. (2020) however wanted to investigate if a temporary period in pasture affected the welfare of horses that were otherwise individually stabled. Four out of the

15 horses being kept on pasture for a temporary period displayed stereotypies pre pasture, and 12 out of 15 horses displayed stereotypies during the five first days back in the stable, after a period of 3 months on pasture (Ruet et al., 2020). Stereotypies was also observed after 3 months back in the stable for six out of the 15 horses, and one horse that displayed stereotypic behaviour pre pasture did not display any stereotypies after 3 months back in the stable (Ruet et al., 2020). None of the horses displayed stereotypic behaviour during the time on pasture, thus, the study by Ruet et al. (2020) demonstrates that time on pasture can be used to cease stereotypic behaviour and increase welfare. Although one horse ceased its stereotypic behaviour completely, the positive effects from a temporary period on pasture were lost when the horses went back to being stabled (Ruet et al., 2020).

Horses that are kept fully free range spend 24 hours on pasture and have the possibility to graze throughout the day and are thus allowed to perform their natural feeding behaviour. They also show less or even no stereotypic behaviour (Ruet et al., 2020). Therefore, horse owners should strive towards keeping horses in as natural conditions as possible.

5 Natural feeding behaviour are not always possible

Despite that pasture time can increase horse welfare and horses that are kept free range display few, if any, stereotypies, far from all horses are kept in these optimal conditions. For many horses, human convenience is what keeps them from being kept on pasture (Leme et al., 2014; McGreevy, 1997). Furthermore, stables located in urban areas often do not have enough land to keep horses in pastures (Leme et al., 2014). However, there are reasons why some horses cannot be kept free range, and for these horses, even a temporary period on pasture could have devastating consequences (Harrison & Murray, 2016).

Grass is a source of carbohydrates and have an extra high content of sugar when it is growing fast (Harrison & Murray, 2016). Thus, grazing should be limited for horses that are obese, or are prone to obesity, especially at times of increased grass growth. Not only can the obesity itself cause welfare problems for the horse, but it can also lead to diseases such as laminitis (Harrison & Murray, 2016). Laminitis can be pasture-induced, meaning caused by intake of grass, and horses that get laminitis often has a higher intake of grass than horses that do not get

laminitis (Harrison & Murray, 2016). It has also been shown by Wylie et al. (2013) that horses that has recently gained bodyweight is at higher risk of getting laminitis.

Laminitis is a sickness that can be either acute or chronic and it can have several causes (Wylie et al., 2013). The horse's hoofs are affected when it suffers from laminitis, by weakening of the tissue binding the hoof bone to the hoof wall (Royal Veterinary College, 2022). For acute cases, the changes of the hoof might stop here, and the horse may recover. However, for chronic cases the hoof bone might rotate or sink, causing pain that may be so severe that the horse has to be euthanized to prevent it from unnecessary suffering (Harrison & Murray, 2016; Royal Veterinary College, 2022; Wylie et al., 2013). In fact, after colic, laminitis is the biggest reason for loss of horse life in the United Kingdom (Harrison & Murray, 2016). However, depending on how severe the chronic laminitis is, the horse may recover after spending weeks or months on box rest with a soft bedding (Royal Veterinary College, 2022).

Having to keep the horse on box rest because of laminitis or for some other reason means it must be individually stabled. This in turn has welfare implications since stabled horses are prone to abnormal behaviour. Thus, emphasising the importance of feeding methods for stabled horses that allow the horse to perform a feeding behaviour that is as natural as possible.

6 Adopting alternative feeding methods to improve horse welfare

6.1 Alternative feeding methods

A fairly easy way to give stabled horses the possibility to perform a more natural feeding behaviour is to use edible bedding such as straw. However, intake of straw could lead to impaction colic and may therefore not be suitable as bedding material (Rochais et al., 2018; Thorne et al., 2005). Furthermore, edible bedding is not always suitable for horses that need food restrictions to lose weight, and a bedding of wood shavings are often used instead (Curtis et al., 2011). A study by Curtis et al. (2011) on overweight horses revealed that horses on food restrictions may consume inedible bedding such as wood shavings to prolong the time spent feeding. This demonstrate that horses are highly motivated to perform their natural feeding behaviour, as well as demonstrating the importance of alternative feeding methods.

An alternative feeding method tested by Thorne et al. (2005) was a comparison of single forage hay and multiple forage containing three types of long-chop forage and three types of short-chop forage. Horses fed single forage spent more time searching for alternative feeds compared to those fed multiple forage, but forage behaviour took place to a larger extent than searching for both treatments (Thorne et al., 2005). However, multiple forage led to a more frequent foraging behaviour which ensued for longer periods compared to when the horses were fed single forage, indicating multiple forage can be used to prolong horses natural feeding behaviour (Thorne et al., 2005). Most horses are fed with single forage, but this study shows that providing horses multiple forage could improve welfare by allowing horses to perform their natural feeding behaviour (Thorne et al., 2005).

Another alternative way that most resemble a natural environment and allows the horse to perform its natural feeding behaviour, thus promoting welfare, is to feed hay *ad libitum* (Morgan et al., 2016; Rochais et al., 2018). This however could lead to the horse consuming more energy than it needs, and *ad libitum* is therefore problematic to adapt in countries like Sweden because of the hay having a high content of energy (Morgan et al., 2016). If less energy dense hay cannot be obtained, methods that allows the horse to perform its feeding behaviour for a lengthened period might be an alternative.

6.2 Slow feeders

Slow feeders are available in different designs and have been created with the purpose of slowing down feeding, thus prolonging feed intake time (Rochais et al., 2018). Common types of slow feeders are hay bags or nets available with bigger or smaller openings, and slow feeders in the form of a bucket with some type of grid or net limiting forage access and thus slowing down feed intake rate (Rochais et al., 2018).

Horses usually fed through a crib, took part in a study by Correa et al. (2020) where the horses acted as their own controls and the experimental method was to feed the horses from a hay bag to investigate if this had positive effects on the horses welfare. The horses were stabled during the whole experiment and the first ten days of the experiment the horses were fed as their usual feeding method through a crib, after which the feeding method changed to a hay bag with 45 mm openings for another ten days (Correa et al., 2020). Measurements on the horses welfare were taken after each ten-day period (Correa et al., 2020). After being fed from a hay bag for ten days the mean time spent feeding on hay increased by 87% when fed 1.8 kg of alfalfa hay,

and by 12% when fed 1 to 1.1 kg of Tifton hay (Correa et al., 2020). The higher increase in time spent on foraging behaviour for alfalfa hay could be because of its structure, the larger amount provided, the alfalfa hay being provided in the morning, or some other reason. Nevertheless, providing hay through a hay bag increased the time a horse spent on foraging behaviour (Correa et al., 2020). Furthermore, a reduction in abnormal behaviours could be seen from an average of 130.6 minutes per day when the horses were fed through their regular feeding method, to an average of 86 minutes per day when fed through hay bags (Correa et al., 2020). Although the study by Correa et al. (2020) showed positive effects on both time spent performing foraging behaviour and resulted in a reduction of abnormal behaviours, not all studies have obtained the same results.

A similar study as the one carried out by Correa et al. (2020) was performed by Rochais et al. (2018) but the regular feeding method for these horses was being fed hay from the ground, and the time spent on the different methods were 3 weeks. The hay bag was also of a different design with one opening towards the bottom of the bag and the possibility to feed from the top of the bag when it was full (Rochais et al., 2018). When feeding the horses through a hay bag instead of feeding them hay from the ground the horses spent more time on foraging behaviour. However, abnormal behaviour and frustration increased when providing hay through a hay bag indicating that hay bags might not be suitable from a welfare approach (Rochais et al., 2018). A slow feeder in the form of a bucket covered by a plate with holes, that the horse could reach hay through, was used as a third feeding method in the study by Rochais et al. (2018). This type of slow feeder increased the time horses spent on foraging behaviour even greater than hay bags did, as well as reduced abnormal and frustration behaviours indicating this type of slow feeder might be more ideal for horse welfare (Rochais et al., 2018).

Correa et al. (2020) and Rochais et al. (2018) used hay bags in their studies and compared hay bags with other feeding methods. This differs from Ellis, Fell, et al. (2015) who instead used haynets in their study and compared them with other brands of haynets. Four different types of haynets were used, three with smaller holes (25 – 30 mm) and one with larger holes (90 mm) (Ellis, Fell, et al., 2015). The haynet with larger holes did not affect feed intake time while the three haynets with smaller holes prolonged feed intake time slightly (5 min/kg) (Ellis, Fell, et al., 2015). The horses were ordinarily given forage through haynets and may thus have learned how to feed from this type of slow feeder resulting in only a small foraging time increase. This is supported by how horses being fed from the haynet with the smallest holes (25 mm)

consumed forage faster in the end of the experiment compared to the beginning (Ellis, Fell, et al., 2015).

Another study using haynets was performed by Ellis, Redgate, et al. (2015) where a comparison of the effects providing forage through a single haynet and feeding forage through multiple haynets during night were made. Furthermore, the multiple haynets was comprised of one single layered haynet, one double layered haynet, and one triple layered haynet, each hanging on one of the four stable walls so that three walls had one type of haynet hanging from it (Ellis, Redgate, et al., 2015). The evening forage were given at approximately 4.30 pm and all haynets were empty in the morning with the exception of the triple layered haynet which at times had a small amount of forage remaining (Ellis, Redgate, et al., 2015). The time each haynet were emptied differed however, the single layered haynet were emptied at roughly 01.38 am, the double layered were emptied at roughly 3.00 am, and the triple layered were emptied, or nearly emptied, at approximately 5.12 am (Ellis, Redgate, et al., 2015). Because morning forage were given at roughly 6:30 am, providing forage through layered haynets and at multiple sites, allowed the horse to perform its natural feeding behaviour throughout the night (Ellis, Redgate, et al., 2015). Furthermore, the horse did not have to spend hours without food when the multiple feeding method were used, which it had to do when only fed through one single layered haynet (Ellis, Redgate, et al., 2015).

Neither Ellis, Fell, et al. (2015) nor Ellis, Redgate, et al. (2015) studied stereotypies in their experiments, although Ellis Redgate, et al. (2015) had 2 crib-biting horses participating and could see that they performed more crib-biting when fed through the layered haynets. The increase of cribbing differed between the two horses, with one horse crib-biting 83% more when feeding from the layered haynets compared to the single layered haynet, while the other horse only increased its cribbing behaviour with 33% (Ellis, Redgate, et al., 2015). Although this was only a comparison between two horses, this demonstrates the necessity of considering the personality of horses when designing studies concerning feeding time budgets, so that welfare implications can be avoided.

7 Conclusions

Keeping horses stabled has welfare implications concerning the ability to perform their natural feeding behaviour, and many horses display stereotypies or other abnormal behaviours because of inadequate feeding regimes. Horses that are kept free range can perform their natural feeding behaviour and display little, if any, stereotypic behaviour and is therefore the most suitable way to keep a horse. However, not all horses can be kept free range due to health reasons making alternative feeding methods for stabled horses important. Implementing alternative feeding methods could prevent or reduce stereotypic behaviour for stabled horses, thus increasing horse welfare, but the method needs to be adapted to the horse since horses respond differently, both physiologically and mentally, to feeding methods.

8 Societal & ethical considerations

Considering this is a literature study, no ethical boundaries are at risk of being crossed by performing an experiment. However, because the animal's welfare potentially is at risk during the experiments performed in the studied literature, the question arises if the benefit that could be gained from those experiments is of value for society. The literature used in this review had the intention to provide methods to improve horse welfare by finding ways that allow horses to perform their natural feeding behaviour. It has been proven that animals are highly motivated to perform natural behaviours and this type of research is therefore important. The experiments were conducted in ways that minimise negative impact on welfare, while also providing relevant findings that can be used to improve horse welfare. Thus, the literature used for this review is of relevance for society.

9 Acknowledgements

I would like to thank my supervisor and my classmates for their input on how to improve my work. I would also like to thank my family who has constantly believed in me, and I would especially like to thank my grandmother who has always been proud of me and given me the strength to achieve my goals with my education.

10 References

- Albright, J., Sun, X., & Houpt, K. (2017). Does cribbing behavior in horses vary with dietary taste or direct gastric stimuli? *Applied Animal Behaviour Science*, 189, 36–40. <https://doi.org/10.1016/j.applanim.2017.01.015>
- Baumgartner, M., Boisson, T., Erhard, M. H., & Zeitler-Feicht, M. H. (2020). Common Feeding Practices Pose a Risk to the Welfare of Horses When Kept on Non-Edible Bedding. *Animals: An Open Access Journal from MDPI*, 10, 411. <https://doi.org/10.3390/ani10030411>
- Cameron, A., Harris, P., Longland, A., Horseman, S., & Hockenhull, J. (2021). UK Horse Carers' Experiences of Restricting Grazing When Aiming to Prevent Health Issues in Their Horses. *Journal of Equine Veterinary Science*, 104, 103685. <https://doi.org/10.1016/j.jevs.2021.103685>
- Correa, M. G., Rodrigues e Silva, C. F., Dias, L. A., da Silva Rocha Junior, S., Thomes, F. R., Alberto do Lago, L., de Mattos Carvalho, A., & Faleiros, R. R. (2020). Welfare benefits after the implementation of slow-feeder hay bags for stabled horses. *Journal of Veterinary Behavior*, 38, 61–66. <https://doi.org/10.1016/j.jveb.2020.05.010>
- Curtis, G. C., Barfoot, C. F., Dugdale, A. H. A., Harris, P. A., & Argo, C. M. (2011). Voluntary ingestion of wood shavings by obese horses under dietary restriction. *British Journal of Nutrition*, 106, 178–182. <https://doi.org/10.1017/S0007114511000547>
- SFS 2018:1192. Djurskyddslag. https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/djurskyddslag-20181192_sfs-2018-1192
- Ellis, A. D., Fell, M., Luck, K., Gill, L., Owen, H., Briars, H., Barfoot, C., & Harris, P. (2015). Effect of forage presentation on feed intake behaviour in stabled horses. *Applied Animal Behaviour Science*, 165, 88–94. <https://doi.org/10.1016/j.applanim.2015.01.010>
- Ellis, A. D., Redgate, S., Zinchenko, S., Owen, H., Barfoot, C., & Harris, P. (2015). The effect of presenting forage in multi-layered haynets and at multiple sites on night time budgets of stabled horses. *Applied Animal Behaviour Science*, 171, 108–116. <https://doi.org/10.1016/j.applanim.2015.08.012>
- Giles, S. L., Harris, P., Rands, S. A., & Nicol, C. J. (2020). Foraging efficiency, social status and body condition in group-living horses and ponies. *PeerJ*, 8, e10305. <https://doi.org/10.7717/peerj.10305>
- Hanis, F., Chung, E. L. T., Kamalludin, M. H., & Idrus, Z. (2020a). Discovering the relationship between dietary nutrients and cortisol and ghrelin hormones in horses exhibiting oral

- stereotypic behaviors: A review. *Journal of Veterinary Behavior*, 39, 90–98. <https://doi.org/10.1016/j.jveb.2020.05.012>
- Hanis, F., Chung, E. L. T., Kamalludin, M. H., & Idrus, Z. (2020b). The Influence of Stable Management and Feeding Practices on the Abnormal Behaviors Among Stabled Horses in Malaysia. *Journal of Equine Veterinary Science*, 94, 103230. <https://doi.org/10.1016/j.jevs.2020.103230>
- Harrison, R., & Murray, J. (2016). A preliminary study of grazing intakes of ponies with and without a history of laminitis. *Livestock Science*, 186, 2–5. <https://doi.org/10.1016/j.livsci.2015.08.012>
- Hartmann, E., Bøe, K. E., Christensen, J. W., Hyypä, S., Jansson, H., Jørgensen, G. H. M., Ladewig, J., Mejdell, C. M., Norling, Y., Rundgren, M., Särkijärvi, S., Søndergaard, E., & Keeling, L. J. (2015). A Nordic survey of management practices and owners' attitudes towards keeping horses in groups¹. *Journal of Animal Science*, 93, 4564–4574. <https://doi.org/10.2527/jas.2015-9233>
- Jordbruksverket. (2022). *Skötsel och stallmiljö för hästar*. <https://jordbruksverket.se/djur/lantbruksdjur-och-hastar/hastar/skotsel-och-stallmiljo> (accessed 11 May 2022)
- Leme, D. P., Parsekian, A. B. H., Kanaan, V., & Hötzel, M. J. (2014). Management, health, and abnormal behaviors of horses: A survey in small equestrian centers in Brazil. *Journal of Veterinary Behavior*, 9, 114–118. <https://doi.org/10.1016/j.jveb.2014.01.004>
- Lesimple, C., Gautier, E., Benhajali, H., Rochais, C., Lunel, C., Bensaïd, S., Khalloufi, A., Henry, S., & Hausberger, M. (2019). Stall architecture influences horses' behaviour and the prevalence and type of stereotypies. *Applied Animal Behaviour Science*, 219, 104833. <https://doi.org/10.1016/j.applanim.2019.104833>
- Lesimple, C., Reverchon-Billot, L., Galloux, P., Stomp, M., Boichot, L., Coste, C., Henry, S., & Hausberger, M. (2020). Free movement: A key for welfare improvement in sport horses? *Applied Animal Behaviour Science*, 225, 104972. <https://doi.org/10.1016/j.applanim.2020.104972>
- McGreevy, P. D. (1997). Do stabled horses cope? *Journal of Biological Education*, 31, 207–211. <https://doi.org/10.1080/00219266.1997.9655564>
- Morgan, K., Kjellberg, L., Karlsson Budde, L., Kjell, E., & Ryman, M. (2016). Pilot study on work load management and feed intake time when feeding horses with small mesh haynets. *Livestock Science*, 186, 63–68. <https://doi.org/10.1016/j.livsci.2015.06.005>

- Rochais, C., Henry, S., & Hausberger, M. (2018). “Hay-bags” and “Slow feeders”: Testing their impact on horse behaviour and welfare. *Applied Animal Behaviour Science*, 198, 52–59. <https://doi.org/10.1016/j.applanim.2017.09.019>
- Royal Veterinary College. (2022). *RVC Equine Laminitis Facts and Research*. <https://www.rvc.ac.uk/equine-vet/information-and-advice/fact-files/laminitis> (accessed 9 May 2022)
- Ruet, A., Arnould, C., Levray, J., Lemarchand, J., Mach, N., Moisan, M.-P., Foury, A., Briant, C., & Lansade, L. (2020). Effects of a temporary period on pasture on the welfare state of horses housed in individual boxes. *Applied Animal Behaviour Science*, 228, 105027. <https://doi.org/10.1016/j.applanim.2020.105027>
- Sarrafchi, A., & Blokhuis, H. J. (2013). Equine stereotypic behaviors: Causation, occurrence, and prevention. *Journal of Veterinary Behavior*, 8, 386–394. <https://doi.org/10.1016/j.jveb.2013.04.068>
- Semprebon, G. M., Rivals, F., Solounias, N., & Hulbert, R. C. (2016). Paleodietary reconstruction of fossil horses from the Eocene through Pleistocene of North America. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 442, 110–127. <https://doi.org/10.1016/j.palaeo.2015.11.004>
- Thorne, J. B., Goodwin, D., Kennedy, M. J., Davidson, H. P. B., & Harris, P. (2005). Foraging enrichment for individually housed horses: Practicality and effects on behaviour. *Applied Animal Behaviour Science*, 94, 149–164. <https://doi.org/10.1016/j.applanim.2005.02.002>
- Whisher, L., Raum, M., Pina, L., Pérez, L., Erb, H., Houpt, C., & Houpt, K. (2011). Effects of environmental factors on cribbing activity by horses. *Applied Animal Behaviour Science*, 135, 63–69. <https://doi.org/10.1016/j.applanim.2011.09.001>
- Wylie, C. E., Collins, S. N., Verheyen, K. L. P., & Newton, J. R. (2013). Risk factors for equine laminitis: A case-control study conducted in veterinary-registered horses and ponies in Great Britain between 2009 and 2011. *The Veterinary Journal*, 198, 57–69. <https://doi.org/10.1016/j.tvjl.2013.08.028>