Livestock Science 186 (2016) 59–62

Contents lists available at ScienceDirect

Livestock Science

journal homepage: www.elsevier.com/locate/livsci

A preliminary investigation into the effect of *ad libitum* or restricted hay with or without Horslyx on the intake and switching behaviour of normal and crib biting horses

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ARTICLE INFO

Article history:
Received 9 January 2015
Received in revised form
6 July 2015
Accepted 27 July 2015

Keywords:
Stereotypy
Horslyx
Behaviour
Feed intake
Horse

ABSTRACT

In an attempt to reduce'fibre-belly' and prevent obesity in horses many owners restrict access to hay in the stable. Such restrictions can lead to digestive disturbances and promote the development of stereotypic behaviours.

The objectives of this experiment were to determine if *ad libitum* or restricted forage with or without the molasses based lick, Horslyx, would alter the behaviour in a group of normal and confirmed stereotypic horses.

Two Randomised Block Design trials were conducted simultaneously. Group A consisted of 3 crib-biters and 1 normal horse, while group B contained 4 non-stereotypic (normal) horses. Horses were individually housed in 10 × 12 foot boxes and bedded on dust-extracted shavings with water available *ad libitum*. Diets were *ad libitum* hay, *ad libitum* hay + Horslyx, restricted hay, and restricted hay + Horslyx. For two days of each collection period every horse was individually observed, and an ethogram completed for ½ h 3*x*/day = 6 observation sessions for each horse. Switching behaviour and data for hay and lick intakes were averaged across the 5 days of collection and subjected to Friedman's non-parametric ANOVA with horse, diet and behaviour as fixed factors.

Ad libitum or restricted forage or the presence of a Horslyx had no significant impact on horse behaviour. Crib-biting horses tended to consume less hay 8.81 (±3.60) kg/d and more Horslyx 1.10 (±0.38) kg/d compared with normal horses who consumed more hay at 11.72 (±4.59) kg/d and less Horslyx at 1.01 (±0.45) kg/d respectively, but there was no significant differences between the groups. Crib-biting horses switched behaviour (eating, licking, cribbing, drinking, and looking over the door resting) an average of 40 times more during the 30 min observation sessions than normal horses. Crib-biting horses also licked the Horslyx 1.5 times more than normal horses.

These results confirmed that stereotypic animals are addicted to the reward of the dopamine release, achieved by the action of crib biting, and are thus not influenced by *ad libitum* forage or access to a stable lick. The 4 fold increase in switching behaviour and additional licking by the crib-biting horses suggests an increased transmission of the neurotransmitter dopamine and in this regard licking may promote coping in certain environmental circumstances.

The results of this study suggest that providing a lick in the stable for crib-biting horses gives them another activity to the normal forage consumption and resting actions and may provide another mechanism for dopamine release and thus enhance their 'coping' strategy when confined in stables.

1. Introduction

In order to reduce 'fibre-belly' in race horses and prevent obesity in pleasure horses, many owners restrict access to hay in the stable. Ellis (2010) reported that horses spend 12.5 + 2.5 h per day eating, which is essential for maintaining both digestive and mental health. Any restriction of this normal behaviour can cause digestive disturbances and promote the development of stereotypic behaviours (Ellis, 2012). This is supported by McGreevy et al. (1995) who reported a positive association between stereotypic behaviour in Thoroughbreds when fed less than 6.8 kg of fibre/day. Furthermore, the feeding of concentrates after weaning (a feeding regimen often associated with low forage provision) led to a 4-fold increase in the initial development of crib-biting (Waters et al., 2002), and has also been shown to elicit post-development increases in crib-biting activity (Gillham et al., 1994). Concentrate

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http://dx.doi.org/10.1016/j.livsci.2015.07.021
1871-1413/

feed induced elevations have been attributed to neurotransmission of dopamine (Roberts et al., 2015), and more complex fluctuations in neuro-active molecules such as leptin and Ghrelin (Hemmann et al., 2013). Forage on the other hand, elicits a depression in crib-biting intensity (Hemmings and Hale, 2013) although the precise schedule of forage provision does not impact upon locomotor activity (stereotypic or otherwise) in a 24 h period (Piccione et al., 2013). Therefore, in order to prevent development and lower stereotypy rate in habitual cribbers, increased forage provision would appear to be essential, although the pattern of provision is not important. Finally, it should be noted that in rodent species stereotypy development has a strong genetic component whereby mice of the inbred DBA/2 strain reliably manifest stereotypy following feed restriction, whereas the C57/b strain do not (Cabib and Bonaventura, 1997). As such, alongside environmental factors such as feeding, genotypic predisposition may play an important role in stereotypy manifestation. Indeed, limited pedigree analysis suggests a heritable component of crib-biting, weaving and box-walking (Vecchiotti and Galanti, 1986), although a more recent study into the molecular basis of stereotypy development refute this notion (Hemmann et al., 2014). However, the latter work employed simple candidate gene approach, and undoubtedly extended investigation featuring genome wide analysis techniques is warranted to properly test the genotypic predisposition hypothesis.

From a perceptual angle, stereotypies are commonly regarded as undesirable traits in performance horses as owners believe that these behaviours can have detrimental effects on health status, reflected in lower body condition scores, and increased susceptibility to certain types of colic (Scantlebury et al., 2011). The negative health aspects of stereotypies is further demonstrated by the fact that equine veterinary examinations class stereotypic behaviours as vices, leading to financial depreciation of the animal by up to 50% (McBride and Long, 2001). From the perspective of training and performance (Parker et al., 2009) reported that crib-biting horses demonstrated a bias towards habitual responding in a two choice Tolmans maze. Cognitive inflexibility such as this leads to problems in competition disciplines (*i.e.* dressage) where refinement and adaptation of previously learned responses is required. Learning deficits also extend to simple instrumental tasks not involving locomotion. Hausberger et al. (2007) demonstrated that 70% of crib-biting horses compared with 15% of normal horses were unsuccessful in oral manipulation of a hinged lid for a food reward. Finally, McGreevy (2004) has also noted that crib-biters spent less time resting than normal horses, whereas in other studies bouts of stereotypy are observable at times when control animals would otherwise be sleeping (Hausberger et al., 2007). It is therefore possible that the cognitive deficits cited above could be a consequence of altered patterns of sleep.

Stereotypy is likely to be self-reinforcing, due to the reward aspect of dopamine release (Hahn, 2004) and there is increasing evidence that stereotypic behaviours are coping mechanisms in stressed stable horses (Hemmings et al., 2004; Nagy et al., 2009). As stereotypies are not observed in feral horses indicating lack of stimulus for coping mechanisms, domestic management regimes should provide an environment that will ameliorate the stress of confinement by offering sufficient forage so that horses can live as stress-free as possible.

The objectives of this study were to determine if *ad libitum* or restricted forage with or without the molasses based lick, Horslyx, would alter the behaviour in a group of 5 normal and 3 confirmed stereotypy (crib-biting) performing horses.

2. Method

2.1. Experimental design

Two replicated 4 × 4 Latin Square designed trials were conducted simultaneously. Group A consisted of 4 horses with the confirmed stereotypy of crib-biting and group B 4 non-stereotypic (normal) horses (see Table 1). The 4 × 7 day periods were divided into 2 days dietary adaptation and 5 days data collection. The periods were set on the fact that the content of the basal diet *i.e.*, hay did not alter, the only variations being in amount of hay and access to a Horslyx lick. Duration of the trial was 28 days in total.

2.2. Horses

All eight horses were geldings and ranged in size from 15 hh to 17 hh. Four horses were geldings and typical 'hunter-type' being Thoroughbred X Irish Draught or Thoroughbred X Connemara breed. They were in moderate to good body condition ranging from 420 to 789 kg LW and ranged from 8 to 14 years old. Four of the geldings were Thoroughbred polo ponies which were under light training, being ridden 4 times per week for approx. 30 min at trot and slow canter. Before commencing the trial, all the hunt horses were out at pasture on their summer rest after the hunting season. They received some supplementary mixed species meadow hay once/day hay while at grass. Polo ponies were out at grass all morning and stabled overnight, also receiving *ad libitum* ryegrass hay when stabled. The normal horses (non-stereotypy) consisted of 3 hunter-type horses and 1 polo pony while the stereotypy (crib-biters) consisted of 3 polo ponies and 1 hunter-type.

2.3. Feed

All horses were on fibre diets *i.e.*, hay + pasture before the trial. The hay fed throughout the trial was medium cut perennial rye grass (*Lolium perenne)* hay that was conserved locally at Foss Hill Farm Coates, Cirencester, in summer 2011. The hay was well conserved and baled in big square bales weighing approx. 350 kg each and stored in an open-sided Dutch barn at Foss Hill Farm. Diets consisted of 1 or 2 components. Hay with or without the molassed-based vitamin and mineral supplement block called Horslyx. The Horslyx Original contained: dehydrated Molasses, mono-Calcium Phosphate, Pure Vegetable Oil, Hipro Soya, Sodium Chloride, Calcium Carbonate and Magnesium Oxide with a nutrient analyses of: Oil 6%, Protein 6.5%, Fibre 0.25%, Sugar 33%, Calcium 2.5%, Phosphorus 1.6%, Magnesium 0.4%, Manganese 800 mg/kg, Zinc 1200 mg/kg, Copper 600 mg/kg, Iodine 6 mg/kg, Vitamin B12 220 Mcg/kg, Selenium 5 Mg/kg, Vitamin A 25,000 iu/kg, Vitamin D3 4000 iu/kg, Vitamin E 200 mg/kg and Biotin 2 mg/kg http://horslyx.co.uk/.

Ad libitum amounts were determined during the initial two

Table 1
Latin square design employed for groups A (horses 1 to 4) and B (horses 5 to 8) detailing horse, diet and period.

Diet	Hay *ad libitum*	Hay restricted	Hay restricted + Horslyx	Hay *ad libitum* + Horslyx
Period 1	Horses 1A, 5B	Horses 2A, 6B	Horses 3A, 7B	Horses 4A, 8B
Period 2	Horses 4A, 8B	Horses 1A, 5B	Horses 2A, 6B	Horses 3A, 7B
Period 3	Horses 2A, 6B	Horses 3A, 7B	Horses 4A, 8B	Horses 1A, 5B
Period 4	Horses 3A, 7B	Horses 4A, 8B	Horses 1A, 5B	Horses 2A, 6B