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Considerations for the use of restricted, soaked grass hay diets to promote weight loss in the management of equine metabolic syndrome and obesity

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ABSTRACT

The addition of hay soaking to current nutritional advice for weight loss management for equine obesity lacks clinical evidence. Twelve overweight/obese horses and ponies were used to test the hypothesis that feeding soaked hay at 1.25% of body mass (BM) daily as dry matter (DM) before soaking would elicit weight losses within the target 0.5–1.0% of BM weekly. Six animals were used to evaluate the impact of nutrient-leaching on the digestibility and daily intakes of dietary energy and nutrients. Soaked hay DM was corrected in accordance with the 'insoluble' ADF content of fresh and soaked hays. The ADF-based method was validated using a test-soaking protocol.

Animals fed soaked hay for 6 weeks lost 0.98 ± 0.10% of BM weekly. The most weight loss sensitive animal lost ~2% of BM weekly. Soaking hay did not alter DM gross energy concentrations, incurred losses of water soluble carbohydrates (WSC) and ash and increased acid detergent fibre (ADF) concentrations. Digestibilities of GE, DM, ash and WSC were unaltered but soaking increased uncorrected values for crude protein (+12%) and ADF (+13.5%) digestibility. Corrected DM provision was only 1% of BM daily, providing 64% of maintenance DE requirements, a 23.5% increase in the intended magnitude of energy restriction. Hay soaking leached nutrients, reduced DM and DE provision and was associated with accelerated weight losses over those expected had fresh-hay been fed to the same level. The ADF-based method will allow the predictive evaluation of individual hays to direct feeding management and prevent inadvertently severe DM and energy restriction.

Introduction

Horses and ponies are increasingly maintained for leisure purposes and numerically this sector now dominates the equine populations in industrialised countries (Wyse et al., 2008). Paradoxically, while this transition has improved many aspects of equine welfare, the uncoupling of animal management practices from base-economics has resulted in a dramatic increase in the incidence of equine obesity (Scheibe and Streich, 2003; McGregor-Argo, 2009). Obesity directly compromises animal welfare by constraining the function of internal organs, inhibiting effective thermoregulation and diminishing exercise performance (Dugdale et al., 2011; Argo et al., 2012). Obesity is also a known risk factor for other disease states, including insulin resistance and laminitis (Treiber et al., 2006). The conflation of obesity, perturbed carbohydrate/insulin dynamics and (the potentially life-threatening) laminitis is collectively termed the 'Equine Metabolic Syndrome' (EMS; Frank et al., 2010).

Whether equine obesity is encountered alone or as an element of EMS, controlled weight loss management remains the mainstay of corrective treatments (Dugdale et al., 2010; Argo et al., 2012). Nutritional protocols generally centre on the withdrawal of any concentrate feedstuffs and the restricted provision of forages (Van Weyenberg et al., 2008; Dugdale et al., 2010; Argo et al., 2012). One consensus statement on EMS recommends that obese horses should initially be offered 1.5% of their 'ideal BM' as fresh hay daily and that where necessary, hays should be soaked to ensure non-structural carbohydrate content of <10% (Frank et al., 2010).

Clear, evidence-based definitions of 'clinically safe' rates of weight loss have not been established for obese Equidae. For man and other companion species, clinically safe rates of weight loss are suggested to be in the range of 0.5–2% of body mass (BM) weekly (Packianathan et al., 2005; German et al., 2007). For obese horses and ponies, severe negative energy balance and rapid weight loss may be triggers for potentially fatal hyperlipaemia (Hughes et al.,

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2004). Research ponies reported in studies which either abruptly or gradually restricted obese animals between 80% and ~51% of predicted daily physiological maintenance digestible energy requirements (mDER) have remained healthy throughout (Van Weyenberg et al., 2008; Dugdale et al., 2010; Argo et al., 2012). However, we have previously shown that individual horses and ponies exhibit marked heterogeneity (±55% over 12 weeks) in their weight loss responsiveness to the same level of dietary restriction (Argo et al., 2012). Generic management advice must, therefore, account for variation, both in forage quality and in the metabolic efficiency of the individual animal. These considerations suggest that target weight loss rates between 0.5% and 1% of BM weekly might be appropriate for Equidae.

Soaked grass hays have been increasingly promoted as the forage of choice for weight loss management. Soaking hay in water leaches a variable proportion of the total water soluble carbohydrate (WSC) content (Warr and Petch, 1992; Longland et al., 2011, 2014; Mack et al., 2014). Hay-soaking limits a readily metabolisable source of dietary energy and has been considered advantageous for the nutritional management of obese horses and ponies and for those diagnosed with EMS (Frank et al., 2010; McGowan et al., 2013). However, although an increasing amount has been written with respect to soaked hays, their suitability for offering in restricted quantities to promote weight loss has never been critically evaluated.

This study addressed three related objectives to test the hypothesis that offering hay at 1.25% of BM as daily dry matter intake (DMI) to promote weight loss was 'clinically sound' and suitable nutritional advice. The first objective evaluated the weight loss responsiveness of animals ($n = 12$) offered soaked hay at a level restricted to reflect the American College of Veterinary Internal Medicine (ACVIM) consensus statement advice for the management of controlled weight loss in obese animals (1.5% of BM as hay fresh weight pre-soak or ~1.25% of BM as daily DMI) (Frank et al., 2010). The second objective was to quantify the impact of soak-related nutrient-leaching on apparent daily digestible intakes of dietary energy and key nutrients. A final aim evaluated the ability of a 'test-soaking protocol' to predict DM losses associated with nutrient leaching, in order to more accurately direct nutritional advice in situations where soaked hay is to be limit fed.

Materials and methods

Three sequential studies were performed. Ethical approvals were obtained from the University of Liverpool's Veterinary Research Ethics Committee and informed consent for participation was obtained from all animal owners.

Objective 1: Weight losses associated with the restricted feeding of soaked hay

Twelve privately owned horses and ponies of various heights and breeds were recruited from a population referred to the Philip Leverhulme Equine Hospital for the investigation and management of EMS. The primary objective of animal recruitment was to evaluate the impact of dietary restriction with or without the provision of a nutraceutical (Table 1) on confirmed EMS cases. Data reporting overall weight losses and impacts on carbohydrate/insulin dynamics have been reported by McGowan et al. (2013).

Animals admitted to the trial were mature horses and ponies (10.9 ± 5.1 years, 366.9 ± 144.4 kg BM), were overweight or obese with body condition score (BCS) of 7–9/9 (Kohnke, 1992), with abnormal responses to a combined insulin glucose tolerance test (Eiler et al., 2005) and with no evidence of pituitary pars intermedia dysfunction on clinical or endocrine testing (Table 1). All animals were free of concurrent illnesses and/or treatments and Obel (1948) grade laminitis was < 2. Animals were dental checked and given anthelmintic prophylaxis ahead of the trial start date. Grass hay was from the same batch throughout (Table 2). BM was recorded weekly (to the nearest 500 g) on a calibrated weighbridge (Lightweight Intermediate; HorseWeigh). BCS was measured for each animal using the Kohnke (1992) modification of the system described by Henneke et al. (1983).

For 2 weeks prior to the onset of dietary restriction, all animals were housed, habituated to the handling requirements of the study and offered soaked hay at 2% of BM as fresh-hay, weighed prior to soaking (Table 2). Animals were individually housed in loose boxes (6 × 5 m) and bedded on wood shavings within a single well-ventilated barn. Fresh water was available ad libitum and animals were turned out in pairs to exercise at liberty for 1 h daily, wearing securely fitted, anti-graze muzzles to prevent grass ingestion.

At the end of the pre-trial period, hay provision was restricted to 1.25% of BM as hay DM before soaking and fed for a further 6 weeks. Hay provisions were adjusted weekly for each animal to maintain provision at 1.25% of individual current BM. Daily hay provisions were divided into two equally-sized meals. Each hay meal was placed within a small-gauge 'haylage' net and morning (08.00 h) and evening (16.00 h) haynets were soaked separately. On each occasion, nets were immersed in water (~40 L) at ambient temperature, such that only the top of the net was visible above the water surface. To best reflect normal husbandry procedures in the field, where nets are generally offered and the next set to soak during morning and evening visits, nets to be fed in the morning and evening were water-soaked for 16 h (overnight) and 7 h (by day) respectively. Nets were passively (gravity) drained of excess water for 30 min before feeding.

In accordance with the objectives of the earlier study (McGowan et al., 2013), animals received one of two nutraceutical products (Boehringer Ingelheim) in addition to the daily hay ration (Table 1). Nutraceuticals were provided at 25 g/100 kg BM daily and were based on a mineral supplement derived from marine algae with a bespoke vitamin and trace mineral premix. Proximate analyses of the dry hays and nutrient balancer supplements suggested that the diets were 'complete' and could be expected to provide or exceed daily requirements for protein, vitamins and minerals. In addition, Supplement A contained 40 g/100 g maltodextrin while Supplement B contained 40 g/100 g short chain fructo-oligosaccharides. For the purpose of the present study it is important to note that supplement type had no measurable impact on the rates of BM or BCS loss.

Objective 2: Apparent digestibilities of energy and nutrients in fresh and soaked hays

On termination of the weight loss phase of the study, nutraceutical supplementation was withdrawn from all animals. Six animals from the original study (where

Table 1
Phenotypic summary of the individual animals in each study group for both this (weight loss and digestibility trial) and the preceding study (Supplement trial, McGowan et al., 2013). Data describing breed/type, gender (mare/gelding), age (years), withers height (cm), body mass (BM, kg) at the end of the first and sixth weeks of dietary restriction, BM losses over the 5 weeks of restriction as a percent of Week 1 BM, and body condition score (BCS, Week 1, Week 6 and 5 week-losses; 1, emaciated to 9, obese, after Kohnke, 1992) are presented. Summary data are provided as means ± standard deviation (SD) of the mean. Animals which received nutraceuticals A and B in the earlier trial are listed and the animals used to evaluate the apparent digestibility of fresh (A, $n = 3$) or soaked (B, $n = 3$) hays in the present study are also listed accordingly.

Animal number	Signalment				Body mass			BCS			Supplement group	Digestibility group
	Age	Breed	Gender	Height (cm)	Week 1	Week 6	Loss (%Week 1 BM)	Week 1	Week 6	Loss		
1	21	Pony	Mare	135	417	415	0.48	7.7	8.1	0.4	A	
2	17	TB × Cob	Mare	153	550	536	2.55	7.8	7.3	0.6	A	B
3	8	Welsh Section A	Mare	105	219	200	8.68	7.8	7.2	0.6	A	B
4	12	Shetland	Gelding	103	220	203	7.73	7.0	6.4	0.7	A	
5	7	Welsh Section A	Mare	122	312	294	5.77	8.3	7.4	1.0	A	A
6	12	Welsh cob	Mare	152	466	453	2.79	7.5	7.3	0.2	A	
7	17	Shetland	Mare	91	195	182	6.67	6.4	5.8	0.7	B	
8	9	Crossbred cob	Gelding	155	636	610	4.09	8.1	7.8	0.3	B	
9	4	Welsh Section A	Mare	114	268	257	4.10	8.3	8.1	0.3	B	A
10	6	Welsh cob	Mare	152	477	452	5.24	7.0	5.9	1.2	B	A
11	8	Welsh Section A	Mare	113	254	240	5.51	7.2	7.3	0.0	B	B
12	10	New Forest	Mare	133	389	368	5.40	7.3	7.3	0.0	B	
Mean				**127.3**	**366.9**	**350.8**	**4.92**	**7.5**	**7.1**	**0.5**		
SD				22.5	144.4	142.7	2.29	0.6	0.8	0.4		