

# HAYGAIN

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## hay steamers

### **Wissenschaftliche Studien zu den patentierten Heubedampfungsgeräten HAYGAIN HG 1000 und HG 600**

In der vorliegenden Unterlage finden Sie Kurzzusammenfassungen der durchgeführten Studien. Die gesamte Studie in der veröffentlichten Fassung können Sie jederzeit gerne anfordern unter [office@pferdperfekt.com](mailto:office@pferdperfekt.com)!

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## Experiment 1

James, R. and Moore-Colyer, M.J.S. (2010): The effect of steam treatment on the total viable count, mould and yeast numbers in hay using the Haygain steamer. *European Workshop for Equine Nutrition, Cirencester*, Sept 2010. The Impact of nutrition on the health and welfare of horses. EAAP publication No. 128. Ed Ellis, A., Longland, A.C., Coenen, M and Miraglia, N. p 128-132.

**Introduction:** It is widely recognised that even good quality hay can contain a wide range of fungal spores, bacteria and mite faeces all of which can initiate the debilitating condition Recurrent Airways Disorder (RAO) in horses (McGorum *et al.*, 1993), and Farmers Lung in humans (Kotimaa *et al.*, 1991). This study sought to determine the effect of steaming at high temperatures in the Haygain HG 1000 steamer on the microbial content of hay.

**Method:** A 1g sample was taken from 5 different regions of an intact dry bale of hay. 79 ml of maximum recovery diluting (MRD) solution was added to the sample and the mixture was stomached for 2 minutes whereupon it underwent a series of dilutions which were used to inoculate petri-films specifically designed to grow bacteria, yeasts and fungi. Films were incubated for 3-7 days at 33°C for TVC and 20°C for yeasts and fungi. The intact bale was then steamed for 50 minutes in the HG 1000 and the above procedure repeated. This was repeated with 5 separate bales of hay. Colony numbers were counted and the difference between the dry and steamed hay was determined using the Wilcoxon signed rank test.

**Results:** As shown in Table 1 highly significant ( $P < 0.008$ ) reductions in colonies of bacteria (TVC), fungi and yeasts were seen in the steamed hay compared with the dry hay, indicating that steaming kills most of these potentially harmful microorganisms.

*Table 1. Microbial colony numbers in dry and hay steamed for 50 minutes in the Haygain steamer.*

Microorganism	Dry hay	Steamed Hay	Sig
TVC	381573	4453	0.008
Fungi	$1.85 \times 10^8$	0	0.008
Yeast	6893333	0	0.008

**Conclusions:** The results of this experiment clearly showed that steaming for 50 minutes in the HG 1000 produced hay devoid of fungi or yeast and with an 86% reduction in bacterial contamination. Horses are therefore consuming clean fodder when eating hay steamed in the HG 1000.

## Experiment 2

James, R. and Moore-Colyer, M.J.S. (2013): Hay for horses – The nutrient content of hay before and after steam treatment in a commercial hay steamer. *Proceedings of British Society of Animal Science Conference*, Nottingham April 2013.

**Introduction:** Previous work has shown that soaking can reduce the nutrient content of hay (Moore-Colyer, 1996; Warr and Petch, 1992), whereas steaming 5 kg hay nets did not cause nutrient depletion (Blackman and Moore-Colyer, 1998). This study sought to determine the extent of nutrient loss from complete bales of hay when steamed for 50 minutes at high temperatures in the HG 1000.

**Method:** Samples from 5 areas of each bale, were taken from 30 different bales of hay from all over the UK. The same bales were then steamed for 50 minutes in a Haygain steamer and another 30 samples taken, using the same procedure. Samples were immediately stored in a freezer before being dried in a force-draught oven at approx 60°C whereupon they were analysed for total nitrogen by use of the Leco FP428 nitrogen determinator; sodium, potassium, calcium and magnesium by ICP-AES; phosphorous by colorimetry, water soluble carbohydrates by an automated anthrone method and trace elements by ICP-AES.

**Results** Nutrient losses are detailed in Table 1 below.

*Table 1. Nutrient content of 30 different samples of hay before and after steaming for 50 minutes in the HG 1000*

Nutrient (units)	Dry (mean)	Steamed (mean)	Standard error of mean	Significance (P)
<b>N</b> (%)	1.12	1.19	0.025	0.014
<b>Ca</b> (%)	0.39	0.41	0.027	0.428
<b>K</b> (%)	1.36	1.50	0.068	0.041
<b>Mg</b> (%)	0.12	0.12	0.007	0.407
<b>Na</b> (%)	0.13	0.15	0.025	0.465
<b>P</b> (%)	0.15	0.16	0.008	0.276
<b>WSC</b> (%)	12.6	10.3	0.827	0.009
<b>Cu</b> (mg/kg)	46.5	61.3	15.32	0.341
<b>Mn</b> (mg/kg)	108	124	18.03	0.390
<b>Fe</b> (mg/kg)	288	121	120.3	0.174
<b>Zn</b> (mg/kg)	17.5	23.5	1.54	0.001

**Conclusions:** Steaming for 50 minutes in the HG 1000 had no effect on Ca, Mg, Na, P, Cu, Mn or Fe. The only nutrient to be lost as a result of steaming was WSC which showed a 2.3% loss. This is probably due to partial heat-induced break down of the cellular structure of the hay, allowing nutrient leaching. The loss of WSC would account for the small proportional increases noted in N, K and Zn. The small but significant reduction in WSC may also make this hay a useful fodder when fed to ponies pre-disposed to laminitis.

### Experiment 3

Stockdale, C and Moore-Colyer, M.J.S (2010): Steaming hay for horses – The effect of three different treatments on the respirable particle numbers in hay treated in the Haygain steamer. *European Workshop for Equine Nutrition*, Cirencester, Sept 2010. The Impact of nutrition on the health and welfare of horses. EAAP publication No. 128. Ed Ellis, A., Longland, A.C., Coenen, M and Miraglia, N. p136-138

**Introduction:** It is widely known that even good quality hay contains a high number of respirable particles (those < 5 µm in diameter) and that these particles can initiate the debilitating condition Recurrent Airways Obstruction (RAO) that causes respiratory distress, coughing and nasal discharge. This study sought to determine the efficacy of the HG 1000 steamer at reducing respirable particle numbers in 4 different hays, representing typical hay fed to horses across the UK.

**Method:** Two replicate bales of hay from four different sources (n= 8) were subjected to 3 treatments: dry, 50 minutes steam in the HG 1000 + shaken immediately, and 50 minutes steam and left to dry for 24 hours before shaking. Respirable particle (RP) numbers were measured from a 5 kg sample by shaking vigorously under a cyclone air sampler for 3 minutes. Differences in respirable particle numbers were determined using analysis of variance and lsd test =  $t_{(\text{error df})} \times \text{s.e.d.}$

**Results :** *Table 1. Mean Respirable particle numbers (/kg hay / litre of air) from 2 replicates of four different dry hays*

	Hay 1	Hay 2	Hay 3	Hay 4	s.e.d	Sig
RP numbers	51254 <sup>c</sup>	28506 <sup>b</sup>	12327 <sup>a</sup>	10711 <sup>a</sup>	3897.3	0.005

<sup>abc</sup> Values in the same row not sharing common superscripts differ significantly (P<0.05).

Table 1 shows that significant differences (P<0.05) exist between respirable particle numbers in hays from different areas of the UK. These differences are most likely due to weather conditions during conservation and the dry matter of the hay when stored.

*Table 2. Respirable particle numbers (/kg hay/litre of air) detected in dry, steamed and steamed +24 hours in 4 different hay*

	Dry hay	Steamed Hay	Steamed Hay + 24 hours	s.e.d	Sig
RP numbers	25699 <sup>a</sup>	1586 <sup>b</sup>	5398 <sup>b</sup>	1937.5	0.001

Table 2 demonstrates that steaming a wide range of hays for 50 minutes in the HG 1000 significantly (P<0.001) reduced the respirable particle numbers by 94% compared with dry hay. Moreover steaming the hay and leaving it to rest for 24 hours did not significantly increase the respirable challenge indicating that even after being left for 24 hours steamed hay reduced the respirable challenge to the horse by 79%.

**Conclusions:** Steaming in the HG 1000 was an effective method for reducing respirable particles numbers in all hays, whether only slightly dusty (hay 4) or highly contaminated (hay 1).

## Experiment 4

In vitro fermentation of dry hay and hay steamed for 50 minutes in the HG 1000 Haygain steamer

**Introduction:** Steaming is a commonly used method by which to cook vegetables, increasing their digestibility and palatability, while conserving their nutrient content. This study sought to determine if steaming hay in the HG 1000 would influence the *in vitro* degradation of hay for horses.

**Method:** 6 hay samples (3 dry and 3 steamed) were fermented *in vitro* using equine faeces as the microbial inoculum in the gas production technique of Theodorou *et al.* (1994). Gas volume and pressure readings were taken using a pressure transducer over a 65-hour incubation at 37°C.

### Results:

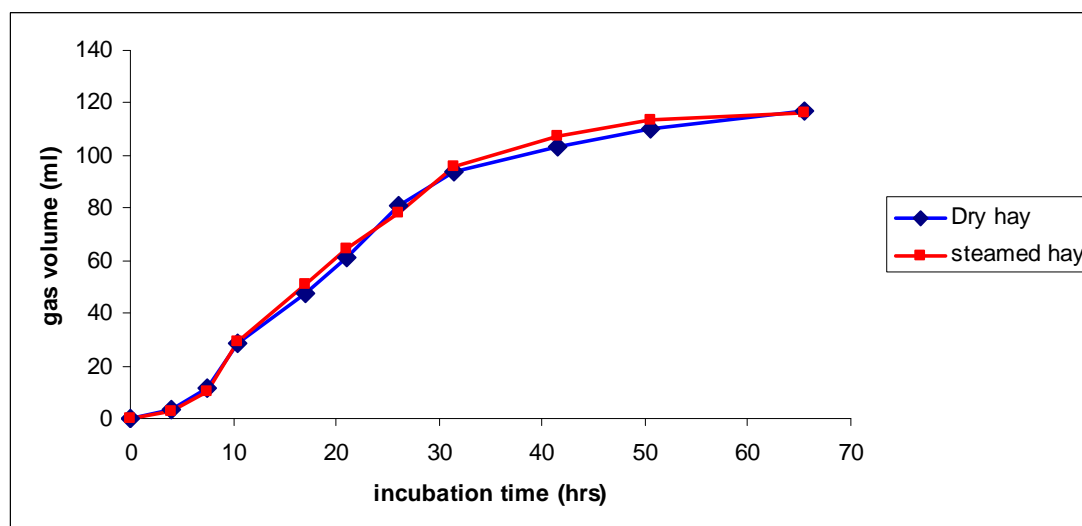


Figure 1. Cumulative gas production profiles for dry hay and hay steamed for 50 minutes in the Haygain steamer

**Conclusions:** As indicated in Fig 1. No significant differences were detected between gas production profiles from dry and steamed hay showing that despite the small reduction in WSC noted in Experiment 2, steaming did not effect the potential degradability of hay in the hind gut of horses.

## Experiment 5

Moore-Colyer, M.J.S. and Payne, V. (2012) Palatability and ingestion behaviour of 6 polo ponies offered a choice of dry, soaked and steamed hay for 1 hour on three separate occasions. *Advances in Animal Biosciences. Healthy Food from Healthy Animals*. Vol 3 part 1. 127

**Introduction:** Steaming has been shown to be an effective alternative to soaking for reducing respirable particles in fodder (Stockdale and Moore-Colyer, 2010). However, to date no information is available on the palatability of steamed vs soaked vs dry hay. The current trial sought to determine the palatability of dry, steamed and soaked hay when offered to 6 Polo ponies for 1 hour, previously fed haylage in a repeated measures design experiment.

**Methodology** Replicate bales of hay were taken from first cut Timothy and Meadow Fescue hay which had been barn-stored for 6 months. Bales were divided into 2. One half was steamed in the HG 600 while 2 x 1 kg hay nets were taken from the other half for the dry and soaked treatments. Six Polo ponies were offered 1 kg each of the dry, soaked and steamed hay simultaneously. The hay was placed on the floor in 3 different corners of a rubber-matted stable, where water was available *ad libitum*. In order to eliminate positional preferences, the experiment was repeated 3 times for each horse with the position of each of the hays being rotated between the 3 corners of the stable. Data was subjected to a repeated measures analysis of variance (Genstat 12). Observations were recorded on the first choice of forage eaten for a consecutive 5 minutes.

### Results:

*Table 1. Average amount of forage consumed in kg (on 95% DM basis) when offered to 6 polo ponies on 3 separate occasions.*

	Steamed	Soaked	Dry	Sed	Sig
Kg of Hay consumed	0.867 <sup>c</sup>	0.050 <sup>a</sup>	0.183 <sup>b</sup>	0.0246	***

abc Values in the same row not sharing common superscripts differ significantly (P<0.001)

**Conclusions:** The results from this experiment clearly demonstrate that horses preferred to consume steamed hay to dry or soaked hay when offered free-choice in a stable environment. Observations of choice of feed revealed that steamed hay once tasted was always the first consumed. Some horses did nibble some dry hay, but quickly returned to the steamed hay until it was all consumed whereupon they then chose to eat the dry hay.

## Experiment 6

Moore-Colyer, M.J.S and Fillery, B.G. (2012) The Effect of three different treatments on the respirable particle content, total viable count and mould concentrations in hay for horses. 6<sup>th</sup> European Workshop for Equine Nutrition, Lisbon, Portugal, June. 101-106.

**Introduction:** Many horse owners soak hay to reduce airborne particles, but soaking is laborious, leaches nutrients (Moore-Colyer, 1996) and the resulting post-soak liquor is an environmental pollutant (Warr and Petch, 1992). In contrast, steaming hay in the HG 1000 has been shown by Stockdale and Moore-Colyer (2010) to reduce respirable particle numbers by 91% and fungal colony numbers by 98% (James and Moore-Colyer, 2010). However, the HG 1000 is too big for many owners and accordingly Propress Equine Ltd has produced the HG 600, a smaller version which steams half a bale and works on the same principles as the HG 1000.

This study sought to compare the efficacy of the smaller steaming chamber in the HG 600, at reducing respirable particle numbers, bacteria, and mould concentrations in five bales of poor-quality perennial rye grass (*Lolium perenne*) hay and to compare steaming with dry hay and hay soaked in water for 10 minutes.

**Method:** Five replicate bales of barn-stored *Lolium perenne* hay made in Hungerford, June 2011, were treated as follows: Half was steamed for 40 minutes in HG 600. Two 4-6kg hay nets were weighed from the other half. One net was soaked in tap water (15°C) for 10 minutes then drained for 10 minutes. Post treatment 1g from dry, soaked and steamed hay were weighed into separate stomacher bags with 79 ml of maximum recovery solution and processed for 2 minutes. Sequential dilutions were prepared down to 10<sup>-4</sup>. Two x 1 ml from each were placed onto 2 x 3 M<sup>TM</sup> petrifilms, (3M Microbiology, St Paul, MN 55144-1000), and incubated for 3-5 days at 20°C (mould films) and 32°C (bacteria), before counting using a standard colony counter. RP were determined according to the method of Moore-Colyer, (1996). Differences between treatments were determined using ANOVA on log transformed data.

**Results:** Table 1. Geometric mean numbers of respirable particle (RP), total bacterial colonies (TVC) and mould colonies (Mould) from 5 bales of hay steamed for 40 minutes in the HG 600 (steamed), soaked for 10 minutes in water (wet) and dry hay (dry).

	Dry	Wet	Steamed	s.e.d	Sig
RP (/l air/kg DM)	1327 <sup>a</sup>	0 <sup>b</sup>	1.47 <sup>b</sup>	1.719	P<0.001
TVC /g	21,877,616 <sup>a</sup>	37,153,522 <sup>a</sup>	83,176 <sup>b</sup>	2.55	P<0.001
Mould /g	1,174,897 <sup>a</sup>	316,227 <sup>a</sup>	1,072 <sup>b</sup>	1.97	P<0.001

<sup>abc</sup> Values in the same row not sharing common superscripts differ significantly (P<0.001)

**Conclusions:** Steaming in the HG 600 was the most effective treatment for reducing RP, mould and TVC concentrations. Soaking reduced RP but increased TVC and thus cannot be recommended as a treatment for improving the hygienic quality of hay.



## Experiment 7

Leggatt, P. and Moore-Colyer, M.J.S (2013). The effect of steam treatment on the bacteria yeast and mould concentrations in haylage for horses. *Proceedings of British Society of Animal Science Conference*, Nottingham April 2013. p 103

**Introduction:** An increasing number of horse owners choose to feed haylage to their stabled horses. Good quality haylage if well conserved has a high nutrient value and low dust content and can make excellent long forage for performance horses. However, as conservation of haylage is more dependent on air-tight storage than lactic acid fermentation (Muller, 2005), once opened it must be used within 5 days. Exposure to air causes rapid bacterial and fungal growth rendering the forage unpalatable and potentially hazardous to feed. Previous work has shown that steaming hay in the Haygain range of steamers has reduced bacteria and fungi concentrations by >95% (James and Moore-Colyer, 2010; Moore-Colyer and Fillery, 2012) and so this study sought to determine if similar reductions in microbial concentrations could be achieved when steaming haylage.

**Method:** Five bales of commercially produced *Lolium perenne* haylage were randomly selected from a farm in Gloucestershire. Each bale was divided into 4 equal portions. Portion 1 was tested immediately, portion 2 left for 4 days then tested. Portion 3 and 4 were steamed in the HG 600 (Haygain Ltd). Portion 3 was tested immediately post steaming and portion 4 was left for 4 days before testing. All 4 portions underwent the following procedure. One gram was weighed into separate stomacher bags with 79 ml of maximum recovery solution and processed for 2 minutes. Sequential dilutions were prepared down to  $10^{-4}$ . Two x 1 ml from each were placed onto 2 x 3 M<sup>TM</sup> petrifilms, (3M Microbiology, St Paul, MN 55144-1000), and incubated for 3-5 days at 20°C (mould films) and 2- 3 days at 32°C (bacteria), before counting using a standard colony counter. Differences between treatments were determined using ANOVA on log transformed data.

**Results:** Total bacterial counts (TVC) and fungi in fresh haylage, haylage opened for 4 days, freshly steamed haylage and steamed haylage left open for 4 days

CFU	Fresh	Fresh + 4 days	Steamed	Steamed + 4 days	s.e.d
Fungi /g	420	2786	12	128	
Log fungi	2.48c	3.38d	0.45a	1.58b	0.304
TVC/g	41,600	114,000	10	304	
Log TVC	4.556c	5.048c	0.823a	2.092b	0.2701

abc Values in the same row not sharing letters differ significantly (P<0.05)

**Conclusions:** TVC and mould concentrations increase by 64 and 75% respectively in haylage opened for 4 days. Steaming significantly reduced microbial growth and this reduction was maintained (99 and 70% lower respectively than freshly opened haylage) after 4 days aerobic exposure.

## Experiment 8

Blumerich, C.A., Buechner-Maxwell, V.A., Scerratt, W.K., Wilson, K.E., Ricco, C., Becvarova, I., Hodgson, J. and Were, S. (2012) Comparison of airway response of Recurrent Airway Obstruction affected horses fed steamed versus non-steamed hay. *Proceedings of the Annual ACVIM Conference, 2012.*

**Introduction:** Recurrent Airway Obstruction (RAO)-affected horses experience bronchoconstriction and airway inflammation in response to inhalation of aerosolized irritants including hay molds. Steaming hay reduces fungal content, but the effect on the antigenic potential of hay has not been investigated. The aims of this experiment were to test the hypothesis that RAO-affected horses develop less clinical disease when fed steamed versus non-steamed hay and this reduction coincides with decreased hay fungal content.

**Method:** Six RAO-affected horses in clinical remission were divided into two groups and fed *ad libitum* steamed or non-steamed alfalfa hay for 10 days using a two-way cross-over design. All horses had *ad libitum* access to water and a mineral lick throughout the duration of the trial. Hay was steamed using the HG 1000 (Haygain Ltd). Clinical assessment was performed daily. Full assessment performed on days 1, 5 and 10, included upper airway endoscopy, assignment of mucous scores and measurement of maximal change in pleural pressure. Bronchial fluid sampling and cytology were performed on days 1 and 10. Hay core samples were collected pre- and post-steaming and cultured to determine fungal and bacterial concentrations. Differences between treatments were determined using repeated measures ANOVA, mixed model ANOVA, Wilcoxon rank-sum and Wilcoxon two sample tests.

**Results:** Steaming significantly decreased the number of fungi colony forming units in hay. Horses fed non-steamed hay experienced a significant increase in clinical score ( $p < 0.0001$ ) and a trend towards total airway neutrophilia ( $p = 0.0834$ ) during the feeding period, while parameters were unchanged in horses fed steamed hay.

**Conclusions:** These results indicate that steaming reduces the RAO-affected horse's response to hay which coincides with a reduction in viable fungal content of hay.

## Experiment 9

Brookes, R and Lambert, P (2012) Investigations into the bacteria (TVC) and fungi concentrations and palatability of hay steamed in the HG 600 and left for up to 24 hours before testing. *BSc theses, Royal Agricultural College, 2012.*

**Introduction:** Horse owners that wish to restrict hay intake due to adiposity, or those owning only 1 horse, are unable to feed all the treated hay immediately post steaming. While previous research (Stockdale and Moore-Colyer, 2010) has shown that the reduction of respirable particles is maintained 24 hours post-steaming, no information is available on the effect of time on the bacteria and mould concentrations in hay left for up to 10 hours post steaming. Furthermore although Moore-Colyer and Payne (2012) reported increased intakes by horses fed steamed hay compared with either dry or soaked hay, there is no information available on the palatability of steamed hay when left to dry-out for up to 24 hours. These studies addressed the hypothesis that hay steamed and left for up to 24 hours would be less palatable and have significantly more bacteria and mould than hay tested immediately post-steaming.

**Methodology:** Five bales of perennial rye grass/timothy mix hay, harvested from a permanent pasture near Hungerford, UK in 2011 were used in each study. In study1 each replicate bale was steamed in the HG 600 for 50 minutes and organised so that 1 kg of hay that had been steamed 24, 8, 2 and 0 hours could be offered simultaneously in 4 corners of rubber-matted stabling to 3 horses. In order to eliminate positional preferences, the experiment was repeated 4 times for each horse with the position of each of the hays being rotated between the 4 corners of the stable.

The amount of hay consumed and the foraging behaviour of the horses was noted for 1 hour. Data was subjected to a repeated measures analysis of variance (Genstat 12).

In study 2 five bales of the same hay was steamed in the HG 600 and tested for TVC and mould concentrations 0, 2, 6 and 10 hours post-steaming. Each replicate sample was subjected to the following treatment. One gram was weighed into separate stomacher bags with 79 ml of maximum recovery solution and processed for 2 minutes. Sequential dilutions were prepared down to  $10^{-4}$ . Two x 1 ml from each were placed onto 2 x 3 M<sup>TM</sup> petrifilms, (3M Microbiology, St Paul, MN 55144-1000), and incubated for 3-5 days at 20°C (mould films) and 2- 3 days at 32°C (bacteria), before counting using a standard colony counter. Differences between treatments were determined using ANOVA on log transformed data (Genstst 12).

**Results study 1: Palatability of hay steamed in HG 600 for 50 minutes and fed 0, 2, 8 and 24 hours post steaming**

Hours fed post-steaming	0	2	8	24	s.e.d	Sig
Amount consumed /hr in kg	0.260	0.300	0.307	0.273	0.1000	NS

**Study 2: Fungi and bacteria in hay steamed in the HG 600 for 50 minutes and tested at 0, 2, 6 and 10 hours post-steaming**

<b>CFU</b>	<b>Dry</b>	<b>0</b>	<b>2</b>	<b>6</b>	<b>10</b>	<b>s.e.d</b>
<b>Fungi /g</b>	30,530	3.3	2	10	2	
<b>Log Fungi</b>	4.11a	0.26b	0.20b	0.56b	0.20b	0.429
<b>TVC/g</b>	243,400	193.3	438	44	87,126	
<b>Log TVC</b>	4.91a	1.60b	1.40b	1.05b	2.44b	0.899

ab Values in the same row not showing common letters differ significantly (P<0.05)

**Conclusions:** Hay steamed in the HG 600 and left for up to 24 hours was equally palatable to freshly steamed hay when offered free-choice to stabled horses. Steaming reduced (P<0.05) the TVC and fungi concentrations compared with dry hay and this reduction was maintained for up to 10 hours post steaming. Results from these studies show that hay steamed in the HG 600 steamer maintains low TVC and mould concentration for up to 10 hours post steaming and retains its palatability for up to 24 hours. Horse owners can therefore steam hay and feed it 10-24 hours later without compromising the hygienic quality nor palatability of the fodder.

## Experiment 10

Brown, E., Tracey, S. and Gowers, I. (2013): An investigation to determine the palatability of steamed hay, dry hay and haylage. *Proceedings of British Society of Animal Science Conference*, Nottingham April 2013. p 104

**Introduction:** In recent years, hay has been replaced by haylage in the diets of stabled horses. Haylage is reported to be highly palatable but can be too high in nutrients for some horses. Hay is more suitable fodder for many horses but can be dusty and induce respiratory disorders. Steamed hay is dust free and has been shown by Payne and Moore-Colyer (2011) to be more palatable than dry and soaked hay. The aim of this study was to determine which fodder, dry hay, steamed hay or haylage was the preferred fodder for stabled horses.

**Method:** Seven horses stabled at Writtle College Lordships Stud were simultaneously offered 3 hay nets containing either dry hay, haylage or hay that had been steamed for 50 minutes in the HG 600 steamer. Intake was determined by the weight difference in forage, before and after the one hour feeding period. Observations were taken for the first five minutes of each period to record the first, second and third choices of forage. Analysis of variance (ANOVA) followed by a Bonferroni post hoc test were used to determine differences in intake between the 3 forages and Chi squared test to determine differences in first choice of forage.

**Results:** The overall trial results demonstrated a significantly greater ( $P=0.003$ ) consumption of steamed hay ( $6.72\text{kg} \pm 1.17 \text{ s.e}$ ) compared to haylage ( $2.04 \text{ kg} \pm 0.36 \text{ s.e}$ ). However, there was no significant difference between steamed hay and dry hay or between haylage and dry hay. The Chi-squared goodness of fit test showed steamed hay to be chosen most often as the first forage to be consumed, followed by haylage and then dry hay ( $P = 0.003$ ).

**Conclusion:** The results of this experiment demonstrate that steamed hay was the first fodder chosen by horses and they went on to consumed more steamed hay than either haylage or dry hay within the 1 hour feeding period. Steamed hay is therefore a hygienically clean and palatable fodder for stabled horses.

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