

## New Zealand Society of Animal Production online archive

This paper is from the New Zealand Society for Animal Production online archive. NZSAP holds a regular annual conference in June or July each year for the presentation of technical and applied topics in animal production. NZSAP plays an important role as a forum fostering research in all areas of animal production including production systems, nutrition, meat science, animal welfare, wool science, animal breeding and genetics.

An invitation is extended to all those involved in the field of animal production to apply for membership of the New Zealand Society of Animal Production at our website [www.nzsap.org.nz](http://www.nzsap.org.nz)

[View All Proceedings](#)

[Next Conference](#)

[Join NZSAP](#)

The New Zealand Society of Animal Production in publishing the conference proceedings is engaged in disseminating information, not rendering professional advice or services. The views expressed herein do not necessarily represent the views of the New Zealand Society of Animal Production and the New Zealand Society of Animal Production expressly disclaims any form of liability with respect to anything done or omitted to be done in reliance upon the contents of these proceedings.

This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](http://creativecommons.org/licenses/by-nc-nd/4.0/).



You are free to:

**Share**— copy and redistribute the material in any medium or format

Under the following terms:

**Attribution** — You must give [appropriate credit](#), provide a link to the license, and [indicate if changes were made](#). You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

**NonCommercial** — You may not use the material for [commercial purposes](#).

**NoDerivatives** — If you [remix, transform, or build upon](#) the material, you may not distribute the modified material.

<http://creativecommons.org.nz/licences/licences-explained/>

## BRIEF COMMUNICATION: Dairy cows and horses do not select oaten hay based on its greenness

S.J. PAIN<sup>1,2</sup> and D.K. REVELL<sup>1,3</sup>

<sup>1</sup>The University of Adelaide, Agricultural and Animal Science, Roseworthy 5371, South Australia, Australia

<sup>2</sup>Institute of Veterinary, Animal and Biomedical Sciences, Massey University, Private Bag 11-222, Palmerston North 4442, New Zealand

<sup>3</sup>CSIRO Livestock Industries, Private Bag 5, Wembley 6913, Western Australia, Australia

**Keywords:** feed preference; fodder characteristics; dairy cow; horse; oaten hay.

### INTRODUCTION

Domestic and export markets for oaten hay are driven largely by estimates of the quality of hay produced. This assessment is commonly based on the plant of origin and subjective criteria, such as colour, or 'greenness', and general appearance as judged by an observer. However, subjective measures such as these are not always reliable indicators of an animal's response to a hay when offered, in terms of its intake and ultimate performance. Understanding the role of specific plant characteristics that influence plant-animal interactions is crucial for developing ways to reliably predict and manipulate feed quality, or adapt the behaviour and selectivity of livestock towards feed on offer. Voluntary feed intake depends in part on palatability and preference. Feed preferences originate from a functional interrelationship between animal requirements and a food characteristics (Provenza, 1995). To provide a quantitative measure of the acceptability of a feedstuff, a 'preference value' can be obtained by describing the preference of one feed, such as a batch of hay, relative to an alternative feed on offer. The project described here aimed to quantify preference values for 89 oaten hays that differed widely in nutritive value by lactating Holstein-Friesian dairy cows and Thoroughbred horses and to relate those preferences to the nutritive and physical properties of the hays, with particular reference to a measure of hay 'greenness'.

### MATERIALS AND METHODS

The content of dry matter (DM), neutral detergent fibre (NDF), acid detergent fibre (ADF), hemicellulose (Hem), crude protein (CP), water soluble carbohydrate (WSC), and *in vitro* dry matter digestibility (IVD) of 89 oaten hays were assessed by near infrared reflectance spectroscopy (NIRS) and determined by Feedtest, Hamilton, Victoria, Australia. Assessment of hay physical characteristics included a measure of 'greenness' (Scored from 1 = Poor green colour to 60 = Good green colour) using Truegrade Hayscan (Balco Pty Ltd, Balaklava, South Australia), percent leaf as

measured by Agrilink Agricultural Consultants Pty Ltd, South Australia, and shear energy (kJ/m<sup>2</sup>) determined by NIRS (Black, 2007). The term 'preference' as used throughout this report refers to a measure of preference shown for a 'trial' hay when fed against a 'standard' hay, determined from the natural logarithm (LN) of the ratio between the trial hay eaten and the standard hay eaten. Thus preference = LN (total amount of trial hay eaten / amount of total standard hay eaten). An equal preference corresponds to a preference log-ratio of zero, negative numbers correspond to low preferences and positive numbers correspond to high preferences. The preference value measurements involved offering two hays, one 'trial' hay and one 'standard' hay, simultaneously for short periods of 5 minutes for cows and 10 minutes for horses, in adjacent feeders. Four standard hays, labelled as A, B, C and D, were selected to possess a range of nutritive values that would represent the population of hays selected for the entire trial. The intention was for the selected standard hays to provide a range of differing nutritive values, as well as differing intake rates and preference values, against which to test the trial hays. This was confirmed prior to commencing the main oaten hay feeding trial using 28 lactating Holstein-Friesian cows and 22 Thoroughbred horses. Preference values were determined from three replications of each combination with three different animals. A minimum of 30 minutes separated each replication and the position (left or right feeder) of each hay in the combination was alternated. Individual hay preference values were averaged across standard hays. Simple linear regressions were used to examine relationships between the average hay preference values for cows and horses and hay characteristics using the statistical program Minitab<sup>®</sup> 15 (Minitab Inc.). Correlation co-efficients (r) are reported.

### RESULTS

The average preference value for oaten trial hay offered to dairy cows ranged from -4.60 to 2.94,

**TABLE 1:** Estimates of percent dry matter (DM), neutral detergent fibre (NDF), acid detergent fibre (ADF), hemicellulose (Hem), crude protein (CP), water soluble carbohydrates (WSC), and *in vitro* digestibility (IVD) predicted by near infrared spectroscopy, and measurements of greenness, leaf content (Leaf) and shear energy (Shear) for standard oatens hays and the range covered by trial oatens hays. SE = Standard error of the mean.

Characteristic	Oaten standard hays				Oaten trial hays		
	A	B	C	D	Minimum	Maximum	Mean ± SE
DM	91.0	91.3	91.3	92.4	89.3	92.4	91.1 ± 0.1
NDF (% DM)	56.3	53.0	51.3	49.2	40.3	62.2	51.5 ± 0.5
ADF(% DM)	34.1	30.0	29.9	27.5	22.3	40.3	31.0 ± 0.4
Hem(% DM)	22.2	23.0	21.5	21.7	15.0	25.3	20.8 ± 0.3
CP (% DM)	7.1	8.3	5.8	6.3	2.3	13.5	6.6 ± 0.2
WSC(% DM)	12.9	19.1	23.9	32.2	8.9	43.0	26.5 ± 0.8
IVD(% DM)	62.4	66.2	67.0	71.1	56.9	78.6	66.5 ± 0.5
Greenness	28	22	29	22	22	55	31 ± 1
Leaf (%)	31.0	34.0	21.0	35.0	11.0	58.0	33.4 ± 1.1
Shear (kJ/m <sup>2</sup> )	9.7	10.1	10.8	10.2	8.6	12.8	10.8 ± 0.1

**TABLE 2:** Correlation coefficient (r) between the average preference of dairy cows (n = 28) and horses (n = 22), and greenness of hay, with percent dry matter (DM), neutral detergent fibre (NDF), acid detergent fibre (ADF), hemicellulose (Hem), crude protein (CP), water soluble carbohydrates (WSC), and *in vitro* digestibility (IVD) predicted by near infrared spectroscopy, and measurements of greenness, leaf content (Leaf) and shear energy (Shear) of oatens hay.

Characteristic	Correlation coefficient (Significance from zero)		
	Dairy cow	Horse	Greenness
DM	-0.38 (<0.001)	0.00 (0.31)	0.00 (0.38)
NDF (% DM)	-0.70 (<0.001)	-0.53 (<0.001)	0.12 (0.28)
ADF(% DM)	-0.85 (<0.001)	-0.62 (<0.001)	0.00 (0.82)
Hem(% DM)	0.00 (0.81)	0.00 (0.97)	-0.26 (0.01)
CP (% DM)	0.57 (<0.001)	0.52 (<0.001)	0.00 (0.42)
WSC(% DM)	0.39 (<0.001)	0.13 (0.13)	0.20 (0.05)
IVD(% DM)	0.81 (<0.001)	0.57 (<0.001)	0.00(0.89)
Greenness	0.00 (0.73)	0.00 (0.76)	
Leaf (%)	0.24 (0.01)	0.09 (0.20)	0.00 (0.99)
Shear (kJ/m <sup>2</sup> )	-0.64 (<0.001)	-0.57 (<0.001)	0.00 (0.97)

whilst the range of average preference value for the same oatens trial hay offered to horses was much narrower, -2.81 to 2.76. There was a moderate relationship ( $r = 0.66$ ;  $P < 0.001$ ) between the preference values of dairy cows with that of horses. Nutritive value and physical characteristics of the oatens hays are detailed in Table 1. Simple linear regression showed positive relationships ( $P < 0.001$ ) between both cow and horse preferences and the protein content and IVD of the hay ( $R^2 = 0.57$  and  $0.52$  and  $r = 0.81$  and  $0.57$  respectively; Table 2). Cow preference was also related ( $P < 0.001$ ) to WSC ( $r = 0.39$ ). Hay shear, ADF and NDF were negatively related to preference ( $P < 0.001$ ). Relationships tended to be stronger for cow preference compared to horse preference. Hay greenness had no relationship to animal preference, nor was it strongly related to any of the other hay characteristics measured.

## DISCUSSION

Neither cow nor horse preference was influenced by hay greenness. This is an important finding, as hay is commonly assessed subjectively by people on the basis of green colour, on the assumption that it is an indicator of ‘freshness’ and quality. Greenness is presumed to be associated with a higher protein content, a higher WSC content or a higher percentage of leaf material. However, our data indicate the dairy cows and horses assess oatens hay on other traits besides greenness and, furthermore, that greenness is not associated with any of the other nutritive or physical traits measured in this particular trial.

Regression models indicate that IVD was positively related to oatens hay preferences of both cows and horses. This suggests that cows and horses

select against hays that are high in plant structural compounds that take more energy to chew and are less readily fermentable. Indeed, shear, ADF and NDF were found to be negatively related to preference, supporting the notion that hays high in the less digestible structural components of lignin and cellulose, are less preferred by both cows and horses. Fisher *et al.* (1999 and 2002) demonstrated that high ADF content was associated with low preferences in sheep, goats and cattle. Cymbaluk (1990) found that horses were less sensitive to the cell-wall content of forages than ruminants, which is similar to findings in this study (ADF correlation to horse preference  $r = 0.57$ , whilst with cow preference  $r = 0.84$ ). Horses appear to be less sensitive to appetite control via physical mechanisms than ruminants (Dulphy *et al.*, 1997). Horses lack the reticulo-omasal orifice found in ruminants which is highly sensitive to large forage particles. However, plant structural components were not the only drivers of oaten hay preference. Dairy cow and horse preference was also positively related to CP. Fisher *et al.* (1999 and 2002) demonstrated that low CP content was associated with low preferences in sheep, goats and cattle. One of the main differences between horses and dairy cows was that WSC were not significantly related to horse preferences but were positively related to cow preferences. This finding is contrary to that of Randall *et al.* (1978) who concluded that horses showed a preference for sweet foods which they associated with higher energy contents. WSC content whilst positively influencing the preference of oaten hay for cows but was of less 'selective' importance than IVD, ADF, NDF or CP.

In summary, the data presented here suggest that measurements related to the structural components of hay, such as ADF, NDF, IVD and shear, may be more reliable indicators of animal preference and subsequent voluntary feed intake, than subjective criteria such as hay colour or greenness.

### ACKNOWLEDGEMENTS

The authors would like to acknowledge the work of our research team and also Balco Australia and Gilmac Pty. Ltd. for their donations of oaten hay and RIRDC Fodder Crops Program for funding this research.

### REFERENCES

- Black, J. 2007: Specification of fodder quality, Publication No. 07/124, Project No. JLB-3A. A report for the Rural Industries Research and Development Corporation (RIRDC), ACT, Australia.
- Cymbaluk, N.F. 1990: Comparison of forage digestion by cattle and horses. *Canadian journal of animal science* **70**: 601-610.
- Dulphy, J.P.; Martin-Rosset, W.; Dubroeuq, H.; Jailler, M. 1997: Evaluation of voluntary intake of forage trough-fed to light horses. Comparison with sheep. Factors of variation and prediction. *Livestock production science* **52(2)**: 97-104.
- Fisher, D.S., Mayland, H.F. and Burns, J.C. 1999: Variation in ruminant's preference for tall fescue hays cut at sundown or sunup. *Journal of animal science* **77**: 762-768.
- Fisher, D.S., Mayland, H.F., and Burns, J.C. 2002: Variation in ruminant preference for alfalfa hays cut at sunup and sundown. *Journal of crop science* **42**: 231-237.
- Provenza, F.D. 1995: Post-ingestive feedback as an elementary determinant of food preference and intake in ruminants. *Journal of range management* **48**: 2-17.
- Randall, R.P., Schurg, W.A., Church, D.C. 1978: Responses of horses to sweet, salty, sour and bitter solutions. *Journal of animal science* **47**: 51.