NUTRITIONAL VALUES OF HAYS AND BUYER PREFERENCES

J.L. CORBETT*, G.M. HOUGH* and J.J.F. de SALIS**

SUMMARY

Fifty-one hays of various types were collected from northern NSW growers. The prices of lucerne hays and values assessed by hay users were about 25% greater than for legume plus grass hays and cereal hays with or without legumes though organic matter digestibilities were similar. Other hays analysed included grass, sorghum and millet. Means for and variation in digestibility and contents of crude protein, fibre, and some major and trace minerals are presented.

INTRODUCTION

A wide range of hays is produced but there is little objective information readily available to guide buyers. This paper reports chemical and other assessments of hays obtained from northern NSW growers in spring 1978.

MATERIALS AND METHODS

Two bales of each of 51 crops of hay and four straws were obtained. Information collected was plant species and cultivar(s) and date sown, soil type, fertilizer usage and other management, date and stage of growth at cutting, rainfall between mowing and baling, type and duration of storage, weights of 10 to 20 bales, and price except for some lots from non-commercial sources. The types of hay (nos. of each) were: Hunter River lucerne (10) including six "grassy": aphid-resistant lucernes DK185 (4), WL512 (1) and CUF101 (1); oaten (13) including six containing clovers; wheaten (4); grasses (6); grasses with clovers (6): forage sorghum (2); millet (2); red clover (1); triticale (1) and oats (2), barley (1) and wheat (1) straws. All were stored in a fully enclosed shed for about four months before analysis.

A stainless steel tube, 25 mm internal diameter and about 550 mm long with a hardened steel scalloped cutting edge, was attached by a bayonet fitting to an adaptor in the chuck of an electric drill (0.35 kW, 350 RPM). As the tube rotated it was pushed into the end of a bale, and four such core samples, about 150 g total, were taken from each pair of bales. These samples from all 55 lots were ground through a 1 mm screen. Organic matter (OM) content was determined from loss on ignition at 600°C for 3 h, and its digestibility in vitro by the method of Tilley and Terry (1963); nitrogen (N) was determined by Kjeldahl, and acid- and neutral-detergent fibres as by Goering and Van Soest (1970); Ca, P, S, Mg, Na, K, Fe, Cu, Mn, Mn and Zn were determined by emission spectrophotometry (Johnson and Simons 1972).

Voluntary intake by sheep

Four lucerne hays were each fed in chaffed form for about three weeks to nine Corriedale castrated male sheep about 10 months old and 31 kg mean live weight: Two were Hunter River one of these about 30% grass and the others were DK185 and CUF101. Quantities given daily to each sheep after refusals were collected were 10% greater than the previous day's ad libitum intakes. Results examined were from the last 10 days of the trial.

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Visual assessment

Eighteen hays, seven duplicated (unknown to the assessors) to give 25 bales, were arranged in random order in a circle for display at a meeting of the New England Branch of the Society. About 50 Members and visitors including many graziers were asked to value these; lucerne, oaten and grass bales with market prices shown were displayed for reference.

RESULTS

Composition and digestibility

Many hays had been collected just after baling. When taken out of store about four months later their weight was less on average \( (n=36) \) by \( 13.5\pm6.9\% \); actual mean weight was then \( 24.5\pm3.0 \) kg, or 41 bales per tonne. Composition and digestibility of the red clover were not specially distinctive from those of the lucernes and it is included (Table 1) in the 'Lucerne' class. 'Cereal' comprises oaten, wheaten and triticale hays; 'Grass' includes phalaris and ryegrass; and these and other grasses in mixtures with clovers and lucerne form the 'Legume plus grass' group.

| TABLE 1 Mean values with SD for numbers (n) of hays in various classes of percent organic matter digestibility in vitro (OMD) and concentrations, g per kg dry matter, of OM, crude protein \((CP=nitrogen \times 6.25)\), acid- and neutral-detergent fibres \((ADF, NDF)\), and four mineral elements |

<table>
<thead>
<tr>
<th></th>
<th>Lucerne</th>
<th>Legume + grass</th>
<th>Oaten + legume</th>
<th>Cereal</th>
<th>Grass</th>
<th>Forage Japanese sorghum millet</th>
</tr>
</thead>
<tbody>
<tr>
<td>( n )</td>
<td>11</td>
<td>12</td>
<td>6</td>
<td>12</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>OMD</td>
<td>67.0(\pm5.4)</td>
<td>65.5(\pm2.9)</td>
<td>68.4(\pm2.9)</td>
<td>63.0(\pm5.3)</td>
<td>55.9(\pm9.9)</td>
<td>56.2 (69.5)</td>
</tr>
<tr>
<td>OM</td>
<td>898 (\pm13)</td>
<td>917 (\pm12)</td>
<td>909 (\pm4)</td>
<td>921 (\pm14)</td>
<td>930 (\pm14)</td>
<td>874 (880)</td>
</tr>
<tr>
<td>CP</td>
<td>202 (\pm20)</td>
<td>125 (\pm39)</td>
<td>137 (\pm38)</td>
<td>79 (\pm25)</td>
<td>71 (\pm18)</td>
<td>87 (96)</td>
</tr>
<tr>
<td>NDF</td>
<td>366 (\pm51)</td>
<td>398 (\pm24)</td>
<td>355 (\pm25)</td>
<td>400 (\pm49)</td>
<td>433 (\pm48)</td>
<td>464 (396)</td>
</tr>
<tr>
<td>ADF</td>
<td>504 (\pm13)</td>
<td>639 (\pm87)</td>
<td>577 (\pm70)</td>
<td>690 (\pm50)</td>
<td>770 (\pm88)</td>
<td>750 (770)</td>
</tr>
<tr>
<td>Ca</td>
<td>10.5(\pm1.6)</td>
<td>5.1 (\pm2.8)</td>
<td>6.6 (\pm3.4)</td>
<td>1.6 (\pm1.4)</td>
<td>1.5 (\pm0.6)</td>
<td>2.2 (4.7)</td>
</tr>
<tr>
<td>P</td>
<td>2.7 (\pm0.6)</td>
<td>2.1 (\pm0.7)</td>
<td>2.2 (\pm0.3)</td>
<td>2.2 (\pm0.5)</td>
<td>1.7 (\pm0.8)</td>
<td>1.7 (4.1)</td>
</tr>
<tr>
<td>Mg</td>
<td>2.9 (\pm0.6)</td>
<td>2.5 (\pm0.6)</td>
<td>3.0 (\pm1.0)</td>
<td>1.7 (\pm0.2)</td>
<td>1.8 (\pm0.3)</td>
<td>2.5 (3.7)</td>
</tr>
<tr>
<td>S</td>
<td>2.3 (\pm0.4)</td>
<td>1.9 (\pm0.4)</td>
<td>1.9 (\pm0.6)</td>
<td>1.5 (\pm0.4)</td>
<td>1.4 (\pm0.3)</td>
<td>1.5 (3.1)</td>
</tr>
</tbody>
</table>

Hays that were wholly or partly leguminous, and 'cereal', were similar in digestibility \( (OMD) \). Lucerne had the highest contents of crude protein and major minerals; contents in the legume mixtures were directly related to the proportions of lucern or clovers present. Grass hays had lower and more variable OMD that reflected directly their stages of growth, and sorghum was similarly low. The two samples of millet had surprisingly high OMD, perhaps reflecting an ADF content of less than 40%. The two samples of oat straw and the wheat and barley straws had OMD of respectively 38, 35 and 50%, and crude protein 3 to 4.5% in DM. Using results from all hays, relationships between OMD, and contents of N, ADF, or NDF were imprecise; residual SD were \( 9.2, 5.4 \) and 7.4 respectively. Nitrogen:sulphur ratios ranged from 4.95 (millet) to 14.05 (lucerne). Of other minerals (DM basis) Na was generally in the range 0.4 to 0.7 g/kg though two wheaten and a sorghum contained 0.1; K varied from about 12 to 28 g/kg. The ranges (mg/kg) for minor and trace minerals were: Fe, 150 to 1100; Cu, 4 to 11 though in three oaten and one wheaten hay it was
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2 to 3; Mo, <1 to 6; Mn, 20 to 40 though in three wheaten hays it was 18;
and Zn, 22 to 33.

Voluntary intake

The Hunter River, grassy Hunter River, DK185 and CUF101 hays had OMD of
respectively 63.6, 68.0, 62.8 and 66.4%. Intakes of DM did not differ
(P > 0.05) between these: mean intake was 38.0 g/kg live weight, or
89.8 g/kg*75

Purchase prices and assessed values

Lucerne prices were greater than those for the other hays (Table 2). At
the assessment, three classes were represented by three to five sample bales,
some duplicated; results for the other classes are not presented because there
was only one bale in each. Differences in assessed values between duplicates
were not significant. The values (Table 2) favoured lucerne to about the same
extent as the prices.

TABLE 2 Purchase prices and visually assessed values per tonne and per tonne
digestible organic matter (DOM) of various hays relative to lucernes
of 68.1% mean OM digestibility that cost $95 per tonne

<table>
<thead>
<tr>
<th>Class of hay</th>
<th>Per tonne Price</th>
<th>Per tonne Assessed value</th>
<th>Per tonne DOM Price</th>
<th>Per tonne DOM Assessed value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lucerne</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Legume+grass</td>
<td>83</td>
<td>75</td>
<td>90</td>
<td>77</td>
</tr>
<tr>
<td>Cereal</td>
<td>74</td>
<td>70</td>
<td>88</td>
<td>80</td>
</tr>
<tr>
<td>Oaten+legume</td>
<td>/1</td>
<td>-</td>
<td>76</td>
<td>-</td>
</tr>
<tr>
<td>Grass</td>
<td>46</td>
<td>-</td>
<td>60</td>
<td>-</td>
</tr>
</tbody>
</table>

DISCUSSION

Comments offered while the hays were being collected included 'first cut
lucerne is often poor because it has a lot of rubbish in it', and 'I like hay
to have a bit of seed in it'. The prices and assessed values showed lucerne
hay commands a premium on the market, and that it is not generally recognized
their nutritional value per tonne is determined primarily by stage of growth,
not by species. This is reflected in the Quality Grades defined by the NSW
Department of Agriculture (Percival 1979), though these appear to be preferences
for the racehorse industry. "Choice" applies to lucerne; the best pasture and
cereal hays fall in the second grade "Prime". Specifications recognize that hay
quality is reduced by mould, heating, and other damage, but in the lowest grade
for lucerne "commonly the first cut in spring will be very grassy and can only
be graded as poor". In reality, the grass and 'rubbish' are likely to be at
an early stage of growth and similar to the lucerne in nutritional value.
Lucerne is likely to be the most reliable hay because it is standard practice
to cut it in early bloom, but results and information for cereals (Table 1)
indicated these are usually cut when the grain is just forming and at the milky
stage, and that legumes plus cereals or grasses are usually of good digestibility.
Grasses tend to mature quickly after the inflorescence has emerged. Their
digestibility will be much reduced after only a short delay in harvesting, which
is liable to occur if conservation is on an opportunity rather than a planned
regular basis; the grass hays collected tended to be opportunity crops,
reflected in their low and variable digestibility. The single sample of
barley straw was substantially more digestible than the oat and wheat straws. Further investigation of barley straws is warranted to define their potential as a maintenance feed.

Remarks about the composition of hay in relation to quality were mainly on protein content. Some lucerne hay is ground for inclusion in feeds for poultry, when protein is important, but information gathered showed that in the collection area hay is given to sheep and cattle principally to maintain these in periods of feed shortage. The prime consideration should then be cost per unit DOM; that lucerne tends to be eaten in greater amount than grass hay (Raymond 1969) is irrelevant when feeding is restricted. For dairy cows it would be wiser to purchase hays containing legumes rather than the more costly lucerne. Results of the feeding trial did not support the concern expressed by some that aphid-resistant lucerne might be less acceptable to stock than Hunter River. Mineral contents and N:S ratios were generally within the usual ranges (Spedding and Diekmahns 1972; Moir 1970; Sorghum spp. are generally low in Na (Wheeler 1980). There is an apparent need to promulgate what does primarily determine hay quality, namely digestibility, and information on digestibilities. Several graziers indicated they would like, and be prepared to pay for, a hay analysis service. Full information on the hays is lodged with the Australian Feed Information Centre, CSIRO, Division of Animal Production, P.O. Box 239, Blacktown, NSW, 2148.

ACKNOWLEDGEMENTS

We thank A.D. Johnson, CSIRO Division of Tropical Crops and Pastures, for the analyses by emission spectrophotometry; M.W. Inskip, F.S. Pickering, E.P. Furnival and G.H. Parkinson for assistance in collection and analyses; R.B. Brandschied for making the bale-corer which, powered by a portable generator, can be used in the field; the hay-growers for their cooperation; and Society members for assessment and other information. Work by G.M.H. and J. de S. was towards the degree of B.Rur.Sc.(Hons.), University of New England.

REFERENCES


