Production and nutritive value of mulberry hay as potential feed supplement for ruminants

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ABSTRACT : A study was conducted to evaluate the dehydration time by sun-drying to produce hay and the DM degradation values of the hay of mulberry foliage (Morus alba). The sun-drying duration to produce the hay was significantly ($P<0.05$) longer in foliage of 7-weeks than of 5-weeks old. The leaf fraction dried much faster ($P<0.05$) than the other plant parts and the drying time of the leaf fractions was shorter in 5-weeks than 7-weeks old leaves (19 against 26 hours, respectively). Mulberry hay from 5-weeks old foliage also indicated higher DM degradability when compared to that of 7-week old foliage. Mulberry foliage of five weeks old could be conserved as hay after sun-drying of less than 26 hours and potentially utilized as feed for ruminants.

Key words: mulberry hay, drying, nutritive values, degradability

INTRODUCTION

The availability of cheap feed resources as basal or supplementary diet is important for successful ruminant production in smallholder farming system in the tropics. As compared with the humid tropical zones, the farmers in the drier tropics face inadequate supplies of quality feed for their ruminant stocks under intensive farming, particularly during the long dry season (Noula *et al*, 2004). For example, during the dry season in north east of Thailand, the limited supply of quality roughage has critically affected the milk yield of the dairy cows (Wanapat, 2005). As a result, the use of alternative feed sources has become an increasingly important approach of feeding ruminants to ensure the animals are able to maintain reasonable body condition through the periods of uncertain supply of quality feed.

The need for alternative resources and the excellent characteristics of mulberry are the justifications for the recent great enthusiasm over its intensive cultivation and its use as a feed supplement for cattle and as the main feed for goats (Sanchez, 2002). Mulberry is perennial in nature and adapts well to various soil types. It is mainly associated with sericulture industry where the quality and the quantity of leaf production are important for the silkworm. The high crude protein, minerals and energy contents, and the relatively low fiber fractions of mulberry are important indicators of the high potential of mulberry foliage as a protein and energy supplement for ruminants. This is further substantiated by the high rate and extent of degradation in the rumen, making mulberry a suitable supplement to enhance the utilization of low quality roughage (Saddul *et al*, 2005).

The suitable climatic conditions of the humid tropics produce high yield of mulberry foliage and its conservation in the form of hay is an important strategy to make high quality forage easily available in the farm. Knowing the quality of the hay would encourage a greater cultivation and utilization of mulberry as a feed supplement. This study was conducted to assess the duration needed to suitably dehydrate mulberry foliage by sun-drying and the nutritive values of the hay produced.

MATERIALS AND METHODS

The experimental design consisted of two groups of re-growth, namely 5 and 7-week old re-growth of mulberry foliage. The experimental plot was divided into three sub-plots represented by Block I, II and III. Each block were sub-divided into two parcels that represented re-growth maturity of five and seven weeks in randomized complete block design (Steel and Torrie, 1980; Gomez and

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Gomez, 1984). The plants were sampled (1 parcel = 28 trees) at approximately 2cm from the base of the re-growth and placed into plastic bag. The samples were divided; a portion was made into hay and the balance was divided into three fractions that were processed into (i) whole plant (leaf and stem), (ii) leaf (with petiole) and (iii) stem.

For processing into hay, mulberry foliage was dried on a raised and netted-floor platform and directly dried under the sun. Weighing was done every 3 hours and the duration of sun-drying was calculated for the hay to attain a constant weight at 10% DM content. Samples were then prepared for proximate analyses. Nylon bag dry matter (DM) degradation study was conducted according to the method outlined by Preston (1995). Data on the duration of drying and DM contents were analyzed by randomized complete block design using General Linear Model (GLM) procedure of SAS (1990). There were three treatments based on duration of the drying of sample, namely whole plant, leaf and stem fractions. Nutrient contents of all plant fraction (whole, leaf and stem) as affected by the age (weeks 5 and 7) were compared using Duncan's Multiple range test. Trend of moisture loss of each plant fraction was determined by regression analysis.

RESULTS AND DISCUSSIONS

Table 1 shows the duration of sun-drying of plant fractions of mulberry that were significantly ($P<0.05$) different. Duration of drying the whole plant, leaf and stem of 7-week old mulberry were 24, 15 and 41h, respectively and were significantly ($P<0.05$) longer than the whole plant, leaf and stem of 5-week old mulberry (19, 12 and 26h, respectively). The drying time of stem was significantly ($P<0.05$) longer than whole plant. The drying time for whole plant was significantly ($P<0.05$) longer than the leaf fraction at both ages of maturity, namely 26 and 41h for stem, 19 and 24h for whole plant, and 12 and 15h for leaf fraction, respectively.

Table 1. The duration of sun-drying of plant fractions to attain 10% moisture content of five and seven weeks mulberry foliage.

Maturity, weeks	Plant fractions	Time, h
Five	Whole	19 ± 1.7^{c}
	Leaf	12 ± 0.0^{e}
	Stem	26 ± 1.7^{b}
Seven	Whole	24 ± 0.0^{b}
	Leaf	15 ± 0.0^{d}
	Stem	41 ± 1.7^{a}
SEM		0.68

a, b, c, d mean with the different superscripts for each plant fraction differ significantly ($P<0.05$)

Visually, it was observed that mulberry hay was of high quality. High-quality hay is greenish in color, leafy, soft and pliable, and free from mustiness (Bates, 1994). The green color of the leaves indicates the presence and amount of carotene, the precursor of vitamin A and there were not loss due to bleaching action of the sun and leaching by rain (Etgen and Reaves, 1978). The leafy, soft and pliable nature indicated that the mulberry was cut at early stage i.e. five weeks as was suggested by Saddul (2005). The mulberry hay was free from mustiness because the moisture content was between 5 and 13% even though it was intended to dry to 10% moisture content. Hay containing 12 to 20% moisture can be stored safely (Suttie, 2000) and if the moisture level is above 20% at the time of baling, excessive storage losses associated with heating and molding may occur (Kellems and Church, 2002). However, in the humid tropics, it is not recommended to dry to 20% moisture level because of the high humidity of the environment. The leaf of mulberry hay was easily detached from the stem because it was very dry and brittle. Kellems and Church (2002) reported that leaves shatter were related to two factors, namely dryness of the plant material and roughness of equipment processing

the hay. McDonald *et al* (2002) also reported that during the drying process, the leaves lose moisture more rapidly than the stems causing it to become very brittle and easily shattered by handling. Therefore, mulberry foliage hay needs to be gently handled as it tends to break-up easily. Though the leaf fraction dried most rapidly there was a need to expose the plant longer as the stems needed longer duration of drying.

Dry matter degradation is indicated in Table 2. The DM degradation was rapid with increasing time of incubation, particularly up to 12 h. The DM degradation was relatively slower until 24 hours before becoming constant thereafter. At 0 and 6h of incubation, the DM loss was not significantly ($P>0.05$) different between samples, but became significantly ($P<0.05$) different at 24, 36 and 48h between hay made from five and seven weeks old foliages.

Table 2. DM degradation (%) of hay made from 5 (Hay-5) and 7-weeks old (Hay-7) mulberry foliage from nylon bags incubated in the rumen of sheep.

Sample	Time of incubation, h				
	0	6	12	24	36
Hay - 5	24.4 ± 2.4	46.1 ± 3.1	74.3 ± 6.7[a]	82.8 ± 0.7[a]	83.3 ± 1.3[a]
Hay -7	25.2 ± 2.5	45.3 ± 7.7	67.5 ± 7.7[b]	77.8 ± 1.8[b]	78.5 ± 0.9[b]
SEM	1.1	1.3	0.8	0.5	0.5

[a, b] : Means with the different superscripts within each columns differ significantly ($P<0.05$)
SEM: Standard error of mean

This study showed that the plant maturity influenced the DM degradability. The DM degradability was best when the mulberry hay was made from foliage of five weeks of age. This result is in agreement with other studies (e.g. Saddul, 2005; Kamalak *et at*, 2005; Bal *et al*, 2000; Akbar *et al* 2002) that indicated a reduction of DM degradability with increasing forage maturity. Saddul *et al* (2005) reported that the effect of plant maturity on degradation of mulberry may be associated with the corresponding increase in the structural fiber composition with advancing plant maturity of the mulberry foliage.

CONCLUSION

It is concluded that mulberry foliage harvested at five weeks old is suitable for the production of hay. There is a potential to produce this hay as a protein source for ruminant feeding.

LITERATURE CITED

Preston, T.R. 1995. Tropical Animal Feeding - Manual for Research Workers. FAO Animal Production and Health Paper 126. FAO, Rome Publications.

Akbar, M.A., P. Lebzien, and G. Flachwosky, 2002. Measurement of yield and *in situ* dry matter degradability of maize varieties harvested at two stage of maturity in sheep. Anim. Feed Sci. and Technol. 100: 53-70.

Bal, M.A., R.D.Shaver, K. J. Shinners, J.G. Coors, J.G Lauer, R.J. Strub, and R.G. Koegel. 2000. Stage of maturity, processing, and hybrid effects on ruminal *in situ* disappearance of whole-plant corn silage. Anim. Feed Sci and Technol. 86: 83-94.

Bates, G. 1994. High quality hay production. The University of Tennessee Agricultural Extension service. http://www.utextension.utk.edu/publications/spfiles/sp437a.pdf. Accessed on July 2005.

Etgen, W.M. and P.M. Reaves. 1978. Dairy cattle feeding and management (6th Edn). John Wiley and Sons, New York. pp. 124-134.

Gomez, K.A. and A.A. Gomez. 1984. Statistical procedures for agricultural research (2nd Edn). An International Rice Research Institute Book. A Willey-Interscience Publication, John Wiley and Son, USA. 680p.

Kamalak, A., O. Canbolat, Y.Gurbuz, , A. Erol, and O. Ozay. 2005. Effect of maturity stage on chemical composition, *in vitro* and *in situ* dry matter degradation of tumbleweed hay (*Gundelia tournefortii* L.). Small Rum. Res. 58: 149-156.

Kellems, R. O. and D. C. Church. 2002. Livestock feeds and feeding (5th Edn). Prentice Hall, New Jersey, USA. pp. 654p.

McDonald, P., R.A. Edwards, J.F.D. Greenhalgh, and C.A. Morgan. 2002. Animal nutrition (6th Edn). Prentice Hall, New Jersey. 693p.

Noula, F.S., O.O. Akinbamijo, O.B. Smith, and V. S. Pandey. 2004. Horticultural residues as ruminant feed in per-urban area of the Gambia. Livestock Research for Rural Development 16(6). http://www.cipav.org.co/lrrd/lrrd16/6/noua16037.htm**.** Accessed on May 2005.

Saddul, D. 2005. Evaluation and utilization of *Morus alba* (mulberry) as a protein supplement for ruminant. Ph.D. Thesis, University Putra Malaysia, Malaysia. 270p.

Saddul, D., Z.A. Jelan, J. B. Liang, and R.A. Halim. 2005. Evaluation of mulberry (*Morus alba*) as potential feed supplement for ruminants: The effect of plant maturity on *in situ* disappearance and *in vitro* intestinal digestibility of plant fraction. Asian-Aust. J. Anim. Sci. 18(11): 1569-1574.

Sanchez, M.D. 2002. World distribution and utilization of mulberry and its potential for animal feeding. In: Mulberry for Animal Production (Ed. Sanchez, M.D). Animal Production and Health Paper No. 147. FAO, Rome, Italy. pp. 1-9.

SAS. 1990. SAS/STAT User's guide (Release 6.12) SAS Inst. Inc. Cary, NC, USA.

Steel, R.G.D. and J.H. Torrie. 1980. Principles and procedures of statistics. A Biometrical approach (2nd Edn). McGraw-Hill Book Company, New York, USA. 633p.

Suttie, J.M. 2000. Hay and straw conservation for small-scale farming and pastoral condition. Plant Production and Protection Series, No. 29. FAO, Rome, Italy. 303p.

Wanapat, M. 2005. Cassava Hay: An old crop with innovative impacts as animal feed. Donald Danforth Plant Science Center.

http://www.danforthcenter.org/media/video/cbnv/session6/S6-29.htm. Accessed on July 2005.