Effect of particle reduction in barn dehydrated hay with an active solar roof collector system: total qualitative losses

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Introduction To offer long particle hay is an efficient way to increase physically effective fiber in ruminant ration. However, enhancing particle size can increase selection, mainly by small ruminants. Chopping dry hay can be a health hazard to staff working at unsuitable facilities. Reducing particle size before hay is totally dried could be an alternative to reduce risks. In barn drying systems it is possible to use a self-loading wagon with a chopping system, which can reduce leaf losses during field loading of biomass, but it could increase the exposed surface for development of undesirable microorganisms. The aim of this study was to evaluate how a barn solar dryer and variation in particle size could impact quantitative losses in hay.

Materials and Methods The experiment was conducted at the UE FERLus of INRA. Two hay meadows (1.0 ha each one) were mowed twice embracing 2nd and 3rd cuts after spring. Meadows were composed by multispecies herbage (*Festuca arundinacea*, *Bromus catharticus* & *sitchensis*, *Phleum pratense*, *Medicago sativa* L., *Onobrychis viciifolia*, *Trifolium repens* L. and *Plantago lanceolata*). The main treatments included hay with two theoretical particle sizes (long: 170 mm, short: 85 mm), dehydrated in a solar barn dryer and as a control, the hay was dehydrated on the field (mowed - disc mower without conditioner; and tedded). A self-loading wagon took wilted herbage from the field and chopped it according to the barn treatment. The barn treatments were dehydrated using a dryer system (with an active solar roof collector system), where two rooms were used, one (surface: 36 m^2, volume: 180 m^3) for each particle size. All treatments had dehydration periods divided in wilting and drying. Losses were evaluated by gravimetric and analytical methods. Nylon net bags (volume 3.0 dm^3) were filled with forage samples immediately after mowing (samples were randomly taken in the field, and manually homogenized to reduce the herbage heterogenicity) and loading wagon chopping. At the end of the wilting and drying cicle, the bags were collected (from the field and dryer rooms, respectively) and weighed. The fodder contained in the bags was dried at 60 °C. Bag fodders were sampled, ground at 1 mm and sent to a laboratory for analysis. The samples were analyzed by NIRS technology, calibrated for intercropped forage crops, for ash, CP, NDF, ADF, ADL, WSC and IVDMD. OM, CEL and HEM were calculated. The equation to calcule DM losses was: Losses (g kg DM^{-1}) = (g DMb – g DMe * 1000) / g DMb, where was used: tare (T) of the bag (g); tare + biomass at beginning (WWb - g); tare + biomass at the end (WWe - g); % DM of samples at the beginning of the step (%DMb); % DM of samples that were in the bag at the end of the step (%DMe). Biomass at beginning and end and losses were calculated as: g DMb = g DM of biomass at beginning ((WWb – T) * % DMb); g DMe = g DM of samples at the end of the step ((WWe – T) * % DMe). Estimation of nutritional losses followed the formulation: Losses$_n$ (g kg^{-1} *nI*) = / (1000 * μ_{nI}), Where Losses$_n$ = losses (g kg^{-1}) of compound *n* at step *I* (wilting or drying); μ_{nI} = mean of compound *n* concentration at beginning of the step (% *nI*); DMloss = DM losses (g kg^{-1} MS) at the final step; n_f = concentration of nutritional compound *n* in the hay at the final step. DM total losses were calculated by summing the average wilting losses plus individual bag losses, obtained during the final step, and nutritional losses were calculated using the mean of compound concentration at mowing (μ_{nI}), total losses of DM and nutritional composition of hay. Data were analyzed by PROC MIXED, considering treatments (Field, Barn Long and Barn Short) as fixed effects and mowing as random, with the variance components as a covariance matrix. Means were contrasted to determine the impact of drying technology (Field *vs.* Barn) and particle size in the barn (Barn Long *vs.* Barn Short), being significant at 5% ($P < 0.05$).

Results and Discussion DM losses were different among treatments ($P = 0.027$), impacting in all components losses (Table 1). Contrasting Field and Barn, there were differences in HEM, WSC and *in vitro* digestible DM (dDM) losses. The effect of particle size there were no difference ($P > 0.05$) in losses just of HEM and WSC. Reducing particle size increased the area of water loss, which positively impacted drying, however resulting in higher DM losses (Shepperson and Grundey, 1962). CP losses could be explained by leaching losses in the control hay (field) and intensive microbial activity in the short barn (Waite, 1949).

Table 1 DM and nutritional losses (g kg^{-1} at mowing) measured during haymaking (n, 78)

Item	Field	Barn-dried		SE	Contrast	
		Long	Short		B *vs* F	BL *vs* BS
DM	130	114	132	24.1	0.298	0.013
OM	125	110	128	25.1	0.370	0.023
Ash	176	145	175	21.4	0.104	0.010
CP	117	111	143	22.9	0.351	0.016
NDF	101	74.5	98.2	37.8	0.083	0.013
ADF	88.5	81.6	104	29.5	0.611	0.026
HEM	124	63.2	88.5	62.7	0.002	0.148
CEL	102	78.4	103	27.8	0.169	0.011
WSC	275	155	167	61.0	<0.001	0.681
dDM	148	117	142	31.2	0.027	0.008

Conclusions In the present study, in barn drying system is not recommended to process the material to particle sizes smaller than 170 mm. High temperature and humidity, presumably led to microbial activity and concomitantly greater losses.

References

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