

# Intensive Mechanical Forage Conditioning: Relationship to Increased Animal Utilization

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## Introduction

Intensive conditioning of forage has been shown to improve animal utilization, especially the amount of energy derived from the fiber fraction (Koegel et al. 1992). This raises questions as to the appropriate level of conditioning to realize the potential benefits without over-conditioning, since this increases both capital and operating costs needlessly.

Establishing a relationship between degree of conditioning and increase in animal utilization requires: (1) an objective quantitative measurement of the degree of conditioning and (2) studies which relate rate and/or extent of forage disappearance (in vitro, in situ or in vivo) to degree of conditioning. Such a study was undertaken.

## Methods

Forage samples were prepared and placed in polyester bags to determine in situ disappearance in the rumen. Materials and treatments were: 2 plant species x 3 maturities x 4 conditioning levels x 4 digestion times x 3 fistulated cows (for each species) x 3 replicates = 864 samples.

The materials and treatments used in the in situ study were as follows:

Plant species: alfalfa (3rd cutting) and orchard grass (3rd cutting)

Maturities: 1. late vegetative/prebud, 2. late bud/early flower, 3. late flower/early seed

Conditioning: 1. control, 2. moderate crushing-impact, 3. severe crushing-impact, 4. rotary-impact maceration

Digestion Times: 6, 12, 24, 48 hours

Level of conditioning was measured as the conductivity of forage leachate prepared in a prescribed manner (see USDFRC 1994 Research Summaries).

The rationale for the conductivity measurement was that the higher the number of disrupted cells, the greater the concentration of electrolytes in the leachate. In addition to measuring the leachate conductivity of

each species-maturity-conditioning level combination, each of the six species-maturity combinations was treated in a Waring blender and the conductivity of the resulting leachate measured. This was considered the "ultimate" treatment which would give the maximum attainable leachate conductivity and this would be dependent almost entirely on herbage chemistry. The three conditioning levels were chosen to give conductivities which were well distributed between the control and Waring blender values. Relative conductivity (RC) was defined as the conductivity ratio (%) of a conditioned forage to that of the same forage treated in the Waring blender.

## Results

Conductivity values for the three alfalfa controls averaged 51 micro-siemens while corresponding values for the most severe treatment level averaged 1067. Average conductivity for the Waring blender treatments was 1380 giving average relative conductivities (RC) of approximately 3.7% for the controls and 77% for the most severe treatment.

Dry matter disappearance from the polyester bags is plotted vs. time in Figures 1 and 2 for the least (1) and most (3) mature alfalfa. These data are fitted with straight lines on a log-log plot in accordance with the usual model:  $\text{disappearance} = A(1 - e^{-kt})$ .  $R^2$  values for all fits in Figs. 1-3 exceed 0.95. It can be seen at 6 hr and 12 hr that the % disappearance increases with the severity of the treatment or RC value. By 48 hours the data points for the different treatments tend to converge. The increase in 6 hour DM disappearance of the most severe treatment relative to the untreated control is 28% for the least mature alfalfa and 40% for the most mature.

Figure 3 is a plot of 6 hr dry matter disappearance vs. relative conductivity (RC), a measure of conditioning severity, for the three levels of maturity. Here dry matter disappearance increases with conditioning severity (RC). The largest benefit in dry matter disappearance occurs with the first increment of

conditioning severity. Successive increments of conditioning severity result in ever smaller increases in DM disappearance. While the slopes of the lines fitted to the data become smaller at higher levels of conditioning, there appear to be small increases in disappearance even at the highest level of conditioning ( $70.9 \text{ RC} \leq 86.8$ ) used in this study.

### Conclusions

Electrical conductivity of forage leachate appears to be a useful and convenient measure of level of mechanical conditioning. In addition to correlating well with the severity of treatment, it also correlated well with the rate of disappearance of forage dry matter from polyester bags placed in the rumen. These observations agree with earlier *in vitro* studies (Koegel et al, 1992) showing higher digestibility of severely conditioned forage than of control forage.

### Reference

Koegel, R.G., R.J. Straub, K.J. Shinnors, G.A. Broderick and D.R. Mertens. 1992. An overview of physical treatments of lucerne performed at Madison, Wisconsin for improving properties. *J. Agric. Engr. Res.* 52:183-191.

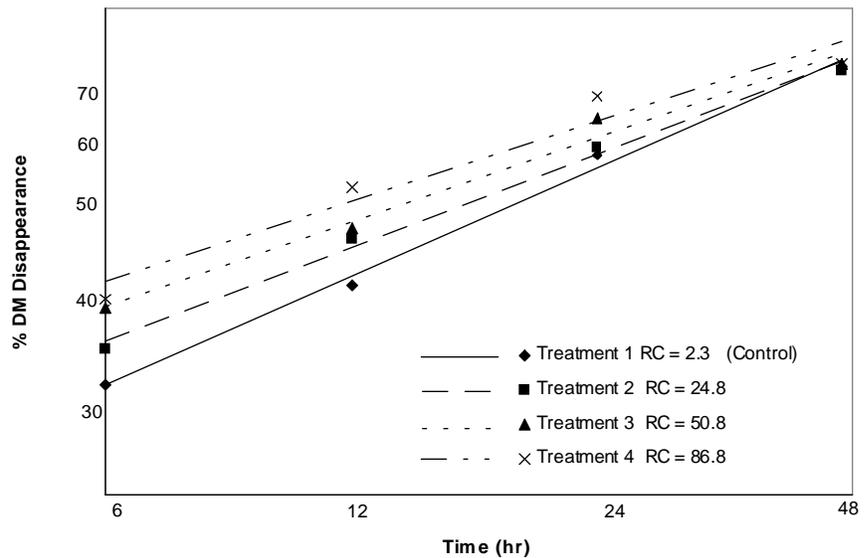


Figure 1. % DM disappearance vs. time. Alfalfa - maturity 1.

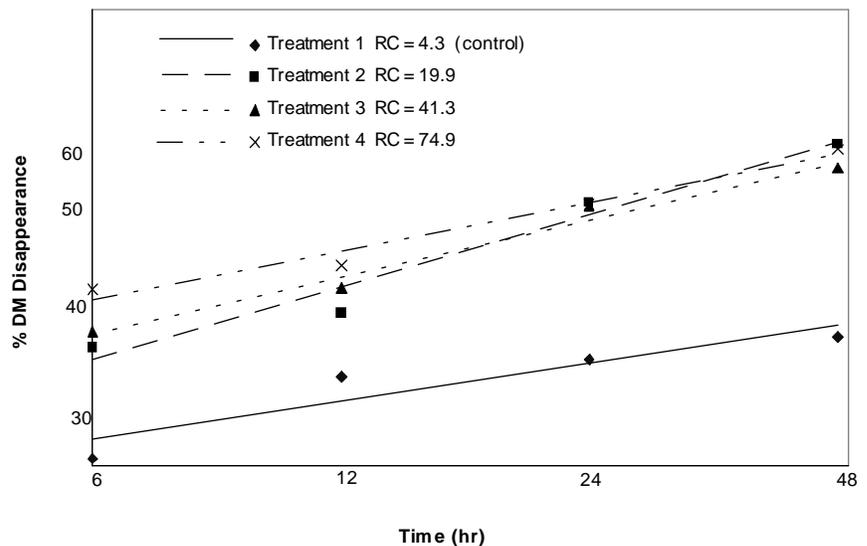


Figure 2. % DM disappearance vs. time. Alfalfa - maturity 3.

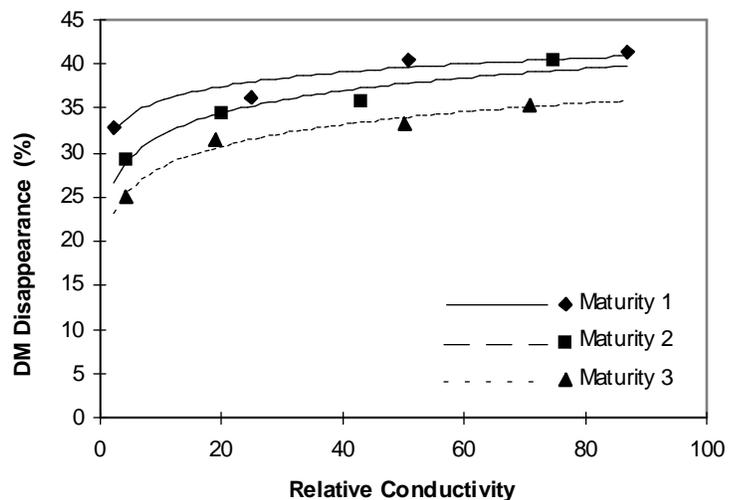


Figure 3. % DM disappearance vs. relative conductivity.