Mechanistic Models of Forage Cell Wall Degradation

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This chapter is concerned primarily with the molecular events that occur when forage plant cell walls are degraded by gut microorganisms. As such it is narrowly focused and is concerned with the individual cell wall or part of the cell wall rather than forages per se. It is important to place these molecular or “mural” events into an appropriate botanical and ecological context and to recognize that many factors other than cell wall composition and architecture influence the nutritive value of a forage and its cell wall fraction when consumed by an animal.

All forages are composed of a heterogeneous population of cell types, each of which has a cell wall with unique properties. Forages differ in the potential nutritive value of their cell wall (fiber) fraction because of differences in both the amount of cell walls derived from the various cell types consumed by the animal and their individual degradabilities. Currently, no routine methods exist for estimating the weight of the various cell types consumed and few measurements have been made of the degradability of cell walls from individual cell types. Certainly no comparative studies between forage species or cultivars based on such methods have been attempted. At best, estimates of leaf, leaf sheath, and stem ratios have been made which reflect, at a morphological level, variations in amounts of different cell types present (e.g., Wilman & Altimimi, 1982; Nordkvist et al., 1987). Although a relatively crude indicator, morphological measurements have the value of demonstrating the importance of changes in the proportion of cell types present in determining the digestion characteristics of the forage. A comparison of barley straw (Hordeum vulgare L.) cultivars with degradability values ranging from 40 to 60% indicated that approximately one-half of the differences in overall cell wall degradability could be attributed to the variation in plant morphology, the more degradable cultivars having the highest leaf blade and lowest stem content (Goto et al., 1991).