Table 1. Carbohydrate fraction of the ration divided into two categories - structural and nonstructural.

Structural (fiber)	Nonstructural (non-fiber)
cellulose hemicellulose lignin	starches sugars pectin

Nonstructural carbohydrates (NSC) represent the more rapidly digested fractions in the rumen. In plants, they are located mostly in the seeds. While different equations have been developed for calculating NSC, in this paper the following equation is used where NDF = neutral detergent fiber.

NSC = 100-(NDF + Crude protein + Fat + Ash)

The fibrous carbohydrates represent the portion of the ration that is more slowly digested. The fibrous carbohydrates occupy more space in the gut and require extensive chewing to reduce the particle size for passage to the lower digestive tract.

The fiber in a ration is analyzed by laboratory procedures for either crude fiber, acid detergent fiber (ADF) or neutral detergent fiber. The NDF procedure measures all the cellulose, hemicellulose and lignin. Crude fiber measures only cellulose and some lignin; ADF measures cellulose and all the lignin. For this reason, ADF appears to be more closely associated with digestibility and NDF to rumen fill or dry matter intake. Since dry matter intake and milk production correlate closely, any component of the ration affecting dry matter intake would affect milk production. Suggested fiber content of rations for high- producing cows is in Table 2.

An experiment was conducted by Staples et al. (1992) to evaluate the value of NDF concentration in diets in order to formulate the desired forage-to-concentrate ratio. Forages selected for the study included corn silage, elephantgrass silage, bermuda silage, and sorghum silage. The forages were adjusted in the diets to give NDF values of 31, 35 and 39 percent. The results are in Table 3.

Milk production averaged nearly 50 lb/day over the 84-day experiment. All silages, except for sorghum silage, supported similar amounts of milk production. Cows consuming sorghum-based diets produced about 3.3 lb/day less milk than cows on other diets. Similar amounts of milk were produced on 31% and 35% NDF rations, but production decreased when cows received diets containing 39% NDF.

Table 2. Fiber guidelines for formulating diets for lactating dairy cows.

Fiber Analysis	Minimum (NRC)[1]	Recommended
Crude fiber	15-17	15-21
Acid detergent fiber	19-21	19-24
Neutral detergent fiber	25-28	25-35[2]
Forage Program		**% of DM**
Corn silage (CS) (only forage)		45-55
CS + 10 lbs alfalfa hay		35-40
Bermuda haylage (35-40% DM)		20-30
CS + 7 lbs cottonseed hulls		35-40
CS + 5 lbs CSH + 5 lbs alf hay		32-40
CS + 7 lbs bermuda hay		32-40
CS + 20-25% high fibrous by-products		40-45
Nonstructural carbohydrates (NSC)		
Minimum		25-33
Optimum		34-38
Maximum		39-45

[1]National Research Council, 1989.
[2]Range varies with forage type and use of by-products.

Corn and alfalfa silage were used in a study by Purdue University workers to measure the performance of early lactation cows fed TMRs formulated to differ in NDF content by varying the amount of forage (silage) in the ration. The forage source used was a 50:50 mixture of corn and alfalfa silage at 41.2, 55.3 and 69.5% (DM) of diets containing 26, 31 and 36% NDF. The results are in Table 4.