

USING A COMPUTER PROGRAM TO DETERMINE THE VALUE OF HAY QUALITY FOR LACTATING DAIRY COWS

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Abstract: A computer program, PCDAIRY, was used to determine relative economic values of alfalfa hay containing 28%-37% acid detergent fiber (ADF). The computer model evaluates palatability and voluntary consumption, as well as digestibility of alfalfa samples of varying maturities as estimated from fiber content. Assuming a price of \$120 per ton for alfalfa hay with 32% ADF, alfalfa with 28% ADF was worth \$7 to \$19 per ton more, and alfalfa with 37% ADF was worth \$9 to \$140 per ton less than alfalfa with 32%, depending on the level of milk production of the cows consuming it.

Keywords: Economic value, computer, fiber, digestibility, palatability, consumption, dairy cows.

INTRODUCTION

High-quality alfalfa must be nutritious and palatable and must be preserved in a manner that will retain these characteristics, whether it is fed as hay, green chop, or silage. Digestibility alone cannot characterize alfalfa quality. To be of greatest value, alfalfa must also be consumed at the highest level possible. High-quality alfalfa will be consumed in greater quantities than low-quality alfalfa, thus magnifying its benefit.

Visual factors have been used to estimate alfalfa digestibility and palatability, including stage of maturity, leafiness, foreign material, condition and odor, and green color. A review of these factors and descriptions of chemical tests to estimate alfalfa quality based on its fiber content are contained in a University of California Cooperative Extension publication - "Testing Alfalfa for its Feeding Value" (1). The publication also contains tables that can be used to estimate relative economic values of alfalfa at various fiber and moisture contents. However, relative economic values are based on digestibility as estimated from fiber content and do not take palatability and consumption into consideration.

A computer program for formulation and analysis of dairy cattle rations, called PCDAIRY (2), can be used to determine the relative economic values of various lots of alfalfa based on their palatability and consumption, as well as nutritional values. The program requires a formulated ration to fulfill all nutritional requirements specified by the National Research Council (3) within feed dry matter intake limits based on cow size and level of milk production. Therefore, the relative economic values determined with PCDAIRY are more accurate than those based only on digestibility.

To illustrate the use of the computer program, a comparison was made of three lots of alfalfa hay with varying fiber contents. Hay lots were characterized by their acid detergent fiber (ADF) contents, but modified crude fiber (MCF) could be used as well. The three lots contained 28%, 32%, and 37% ADF, respectively, which correspond to total digestible nutrient (TDN) levels of 55%, 52%, and 49% TDN at 90% dry matter. For comparison purposes, the lot with 32% ADF was specified to be worth \$120 per ton on the open market, and all three lots contained 90% dry matter. Other feedstuffs available for the rations and their prices were:

<u>Feedstuff</u>	<u>\$ Per Ton</u>	<u>Feedstuff</u>	<u>\$ Per Ton</u>
Almond Hulls	80	Whole Cottonseed	180
Barley Grain	160	Dicalcium Phosphate	500
Beet Pulp	150	Limestone	100
Corn Grain	160	Molasses	90
Cottonseed Meal	200	Rice Bran	140
		Wheat Millrun	150

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Rations were formulated for four levels of milk yields with each of the three hay lots. A summary of milk yields, feed costs, and income over feed costs (IOFC) with the standard hay (32% ADF and \$120/ton) is shown in Table 1. Daily feed costs increased from \$2.88 per cow for 46 lb of milk to \$4.60 per cow for 106 lb of milk. However, daily IOFC increased even faster from \$3.10 per cow for 46 lb of milk to \$8.88 per cow for 106 lb of milk, illustrating the increased profitability of high-producing cows.

In a second set of computer formulations, the price of alfalfa hay with 28% ADF was allowed to vary so that IOFC would be the same as it was for the previous rations using alfalfa hay with 32% ADF at \$120 per ton. The results are shown in Table 2. The relative value of alfalfa with 28% ADF varied from \$127 per ton for the low-yielding cows to \$139 per ton for the high-producers, or an increased value of \$7 to \$19 per ton.

In a third set of computer formulations, the price of alfalfa hay with 37% ADF was allowed to vary so that IOFC would be the same as it was for the standard hay (32% ADF and \$120 per ton). The results are shown in Table 3. The relative value of alfalfa with 37% ADF was \$111 per ton for the low-yielding cows but declined to a negative value for the high-producers. In fact, the computer could not formulate a balanced ration for cows producing more than 89 lb of milk using the alfalfa with 37% ADF even if large amounts of grain-concentrates were fed. This illustrates the well-known fact that high-producing cows must be fed high-quality forages as well as liberal amounts of grain-concentrates in order to maintain high milk yields.

The relative values of the three hay lots at the four levels of milk production are summarized in Table 4. Assuming a price of \$120 per ton for the alfalfa with 32% ADF (55% TDN @ 90% DM), the alfalfa with 28% ADF (55% TDN @ 90% DM) is worth from \$7 to \$19 more per ton depending on the level of milk production of the cows consuming it. Conversely, the alfalfa with 37% ADF (49% TDN @ 90% DM), is worth from \$9 to \$140 per ton less depending on the milk yields of the cows consuming it. The difference in relative values between the 28% ADF and 37% ADF hay lots is from \$16 to \$159 per ton depending on milk yields of cows being fed the alfalfa.

Using Table 6, Relative alfalfa hay values at various ADF percentages, in the bulletin "Testing Alfalfa for Its Feeding Value" (1), the difference in relative economic value between alfalfa hays with 28% and 37% ADF is calculated as \$15 per ton based only on digestibility. This is very close to the \$16 difference determined by PCDAIRY for low-yielding cows, but grossly underestimates the difference in relative values for high-yielding cows. It appears that PCDAIRY could be used by both buyers and sellers of alfalfa hay to establish relative economic values that correspond more closely to the actual nutritional value of alfalfa hay lots offered for sale, depending on the milk yields of cows to which the alfalfa will be fed.

REFERENCES

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Table 1. Milk yields, feed costs, and income over feed costs of cows fed alfalfa hay with 32% ADF.

		Milk Production Group		
		Medium	High	Super
Milk (lb/day)	46	66	86	104
Alfalfa hay (\$/ton)	\$120	\$120	\$120	\$120
Feed costs (\$/day)	\$2.88	\$3.50	\$4.16	\$4.60
IOFC (\$/day)*	\$3.10	\$5.08	\$7.02	\$8.88

Table 2. Milk yields, relative economic values of alfalfa hay, feed costs, and income over feed costs of cows fed alfalfa hay with 28% ADF.

		Milk Production Group		
		Medium	High	Super
Milk (lb/day)	46	66	86	106
Alfalfa (\$/ton)	\$127	\$127	\$131	\$139
Feed costs (\$/day)	\$2.88	\$3.50	\$4.16	\$4.90
IOFC (\$/day)*	\$3.10	\$5.08	\$7.02	\$8.88

Table 3. Milk yields, relative economic values of alfalfa hay, feed costs, and income over feed costs of cows fed alfalfa hay with 37% ADF.

		Milk Production Group		
		Medium	High	Super
Milk (lb/day)	46	66	81	89
Alfalfa (\$/ton)	\$111	\$108	\$81	-0-
Feed costs (\$/day)	\$2.88	\$3.50	\$3.47	\$2.93
IOFC (\$/day)*	\$3.10	\$5.08	\$7.02	\$8.61

Table 4. Relative economic values (\$/ton) of alfalfa hay lots varying from 28% to 37% ADF (55% to 49% TDN at 90% DM).

		Milk Production Group		
		Medium	High	Super
28% ADF (55% TDN)	+\$7	+\$7	+\$11	+\$19
32% ADF (52% TDN)	-0-	-0-	-0-	-0-
37% ADF (49% TDN)	-\$9	-\$12	-\$39	-\$140
Difference (28% ADF vs. 37% ADF)	\$16	\$19	\$50	\$159

*IOFC = Income over feed costs.