

# LINKING MARKETS WITH FORAGE QUALITY

## Where we've been and where are we going?

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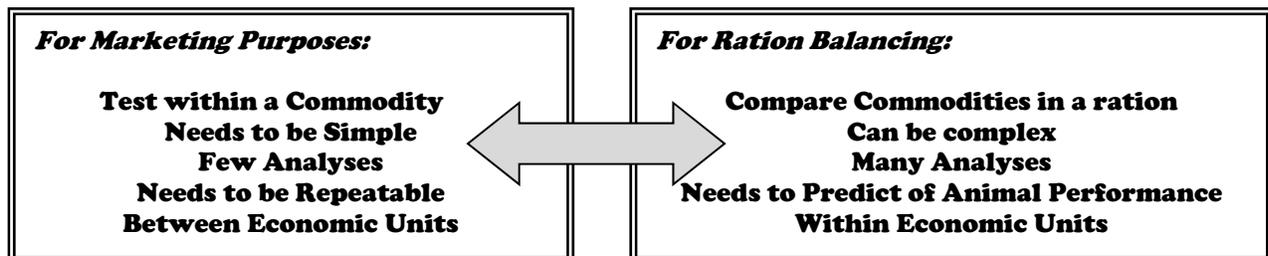
### ABSTRACT

To better understand the interaction and importance of laboratory testing and the pricing and marketing of forages, a survey of professional animal nutritionists was conducted Fall, 2011. The purpose was to develop a better understanding of the sum total 'demand' factors which determine how forage quality should be measured and linked to markets. This survey showed that nutritionists generally prioritize fiber measurements of NDF or ADF, secondarily CP, thirdly a digestibility estimate such as NDFD for marketing of hay. They would like to see digestibility measurements incorporated into hay markets if consistency of measurements can be improved. DM, starch, and NDFD are prioritized measurements for corn silage. Although nutritionists prefer using multiple analyses to evaluate forages, US markets currently primarily use a single fiber measurement to determine price. While there is a need for simplicity in marketing, simply using ADF or NDF, this method often fails to detect important quality features. Most of those surveyed favor a new national standardized equation based upon a widely recognized summative equation, in addition to lab analyses, to be used for marketing. While nutritionists require many analyses for ration balancing, a simpler set is likely to be sufficient for markets. A 'hierarchical' approach to marketing of forages is suggested, with multiple measurements (particularly NDF, CP, NDFD and ASH, and starch in the case of silage) playing important roles, depending upon class of animal, ration approach, and production system. While it is clear that the current system needs to change, new approaches must be science-based, transparent, and based upon as wide a consensus view as possible.

### INTRODUCTION

Hay (alfalfa and misc. hays) is the third most important economic crop in revenue in the US. The value of beef and dairy exceeds that of corn, the most important crop. Thus 'quality' of hay and forage crops, broadly defined, is nothing less than the language of value transfer between

**Figure 1.** The important attributes of forage testing changes for marketing purposes vs. ration balancing. Repeatability and simplicity are critical for marketing purposes, while a high degree of predictability and relationship with other feeds are important for ration balancing.



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several multi-billion dollar agricultural enterprises: primarily dairy, beef and forage crops.

Hay and other forages contribute multiple quality attributes to an animal diet (energy, protein, minerals, functional fiber), not just production of dry matter for feedstuffs. The complex nature of quality itself complicates the estimation of feed quality and creates challenges for buyers and sellers to fix an economic value on a variable but important product. There is a need for simplicity and repeatability for the hay trade, whereas nutritionists often need more details to successfully balance rations (Figure 1). Although others (particularly hay producers, brokers, and dairy managers) are involved in pricing, the ‘rules’ for the relationship of laboratory values to feeding value (and therefore price) are primarily set by nutritionists.

Marketing of hay has been historically based upon subjective factors (e.g. leafiness, leaf attachment, stem coarseness, color, weeds, molds, and odor) and more recently analytical laboratory values (e.g., CP, ADF, NDF, with the calculated values of RFV, TDN from these). In the western United States, it is likely that >90% of the alfalfa and grass hay is marketed either domestically or in world trade. Marketing is less common in eastern states, where a vast majority of hay is fed on-farm, making it less important to ascribe economic value to forage crops. However, marketing is becoming more common in those regions as well. Exports and dairy purchases in particular have expanded greatly in recent years, necessitating quality-defined price discovery. New genetics, such as the down-regulated lignin trait also necessitate better methods to value forage quality in markets. To better understand the interaction and importance of laboratory testing and the pricing and marketing of forages, a survey of professional animal nutritionists was conducted Fall, 2011, results of which are reported here. In this paper, the current methods for defining quality in forage crops for markets are examined, and with speculation on how this might change in the future.

**Table 2. Current USDA Quality Guidelines** for reporting economic data of alfalfa hay (not more than 10% grass) adapted in 2002 (2003 USDA Livestock, Hay & Grain Market News, Moses Lake, WA). Guidelines are used along with visual attributes to determine quality.

**Chemical Descriptions of Hay Quality Guidelines to be used in combination with Physical Descriptions for alfalfa hay quality categories (USDA-Market News):**

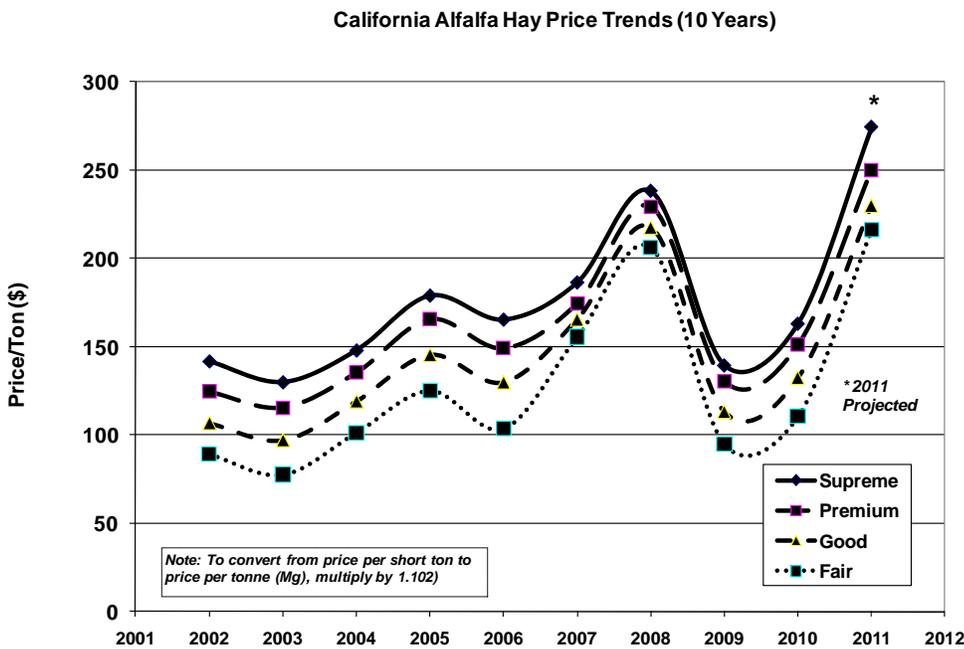
<b>Category</b>	<b>ADF</b>	<b>NDF</b>	<b>*RFV</b>	<b>*TDN</b>	<b>*TDN (90% DM)</b>	<b>CP</b>
			-----%-----			
Supreme	<27	<34	>180	>62	>55.9	>22
Premium	27-29	34-36	150-180	60.5-62	54.5-55.9	20-22
Good	29-32	36-40	125-150	58-60	52.5-54.5	18-20
Fair	32-35	40-44	100-125	56-58	50.5-52.5	16-18
Utility	>35	>44	< 100	<56	<50.5	<16

*RFV is calculated from ADF and NDF:  $RFV = (88.9 - (.779 \times \%ADF)) \times ((120 / \%NDF) / 1.29)$*   
*TDN = {82.38 - (0.7515 x ADF)} according to Bath & Marble, 1989.*  
*TDN (90% DM) = TDN X 0.9.*

## CURRENT FIBER-BASED MARKETING SYSTEM

Currently, USDA recognizes five categories of hay (Table 1), which are tracked for price and volume (USDA-Market News Service). It should be emphasized that these are guidelines, not standards, and that industry participants are generally free to modify these designations to a considerable degree. Nationwide, in the US, alfalfa hay is essentially marketed using ‘fiber-based’ marketing systems. RFV and TDN are the dominant languages of the hay trade, and appear to be superficially different. However, these are simply calculated from the fiber measurements of ADF and/or NDF lab measurements, so they are essentially similar in approach. They are both ‘fiber-based systems’. To be clear: higher fiber values generally equals lower price in current markets. CP and other factors figure in to some degree, but it’s basically driven by fiber. (See NFTA [www.foragetesting.org](http://www.foragetesting.org) for calculations of RFV and TDN, and the

below text box for abbreviations of acronyms).



**Figure 2. Price of alfalfa hay in relation to forage quality, California markets.**

The state of California provides an interesting glimpse into the marketing of forages, since >95% of the hay in this state is marketed. The marketing system in CA is similar to many of the other western states of

OR, WA, ID, UT, NV, AZ, and NM, where about 35-40% of the US alfalfa is grown. During the past 10-year period, average hay prices in this state varied between about \$70/ton to about \$280/ton, influenced by both supply-demand in any given year, and upon quality factors (Figure 2). On a volume averaging 7.4 million tons (6.7 million Mg), averaged across 13 marketing districts, differences in price changed an average of \$6 to \$7 per unit change in % ADF. The influence of quality on hay price is highly dependent upon the supply and demand situation in any given year (Figure 2). It’s worth noting that in ‘high price years’, differences due to quality are smaller than in ‘low price’ years (Figures 1, 2).

**Supply-Demand Influences the Quality-Price Relationship.** In the lowest priced years, high quality hays were worth up to 90% more than the low quality hays, but in a high priced year, the quality premium was only 20-30% more (Figure 3). This is because buyers can be less choosy in a high-price year, and must accept hays of lower quality. Additionally, hay growers are less-apt to sacrifice yield for quality in high price years, producing less amounts of high-quality forage since a ‘yield’ strategy is in their economic interests. Conversely, in low price years with high hay supply, lower quality hay often just simply doesn’t sell, so growers must produce high quality in those years just to be able to sell hay.

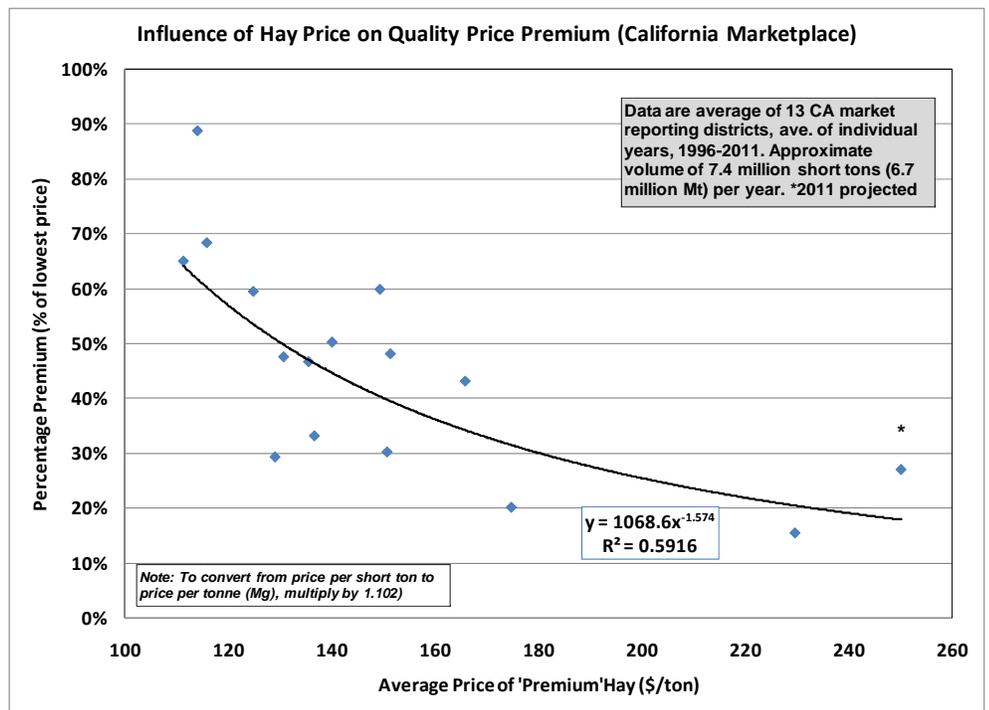


Figure 3. Influence of average price on the premium due to forage quality, CA markets.

## LIMITATIONS OF A FIBER-BASED MARKETING SYSTEM

TDN and RFV systems (which are calculated from the fiber analyses of ADF and NDF) have been very useful in enabling hay markets to develop, and have enabled dairy producers to increase animal output substantially. This system is not unreasonable, due to the fact that most nutritionists want high energy and protein in their forages, which are generally found in lower-fiber hay products. However, some question whether valuing forage simply for ‘low fiber’ makes no sense from a nutritional viewpoint, nor does it serve hay growers, who are forced to cut at ever-decreasing cutting schedules to achieve low fiber in hay. The role of forage fiber in dairy rations is changing. With all the concentrates currently fed, digestible effective fiber (NDF) has played a much more important role in rumen function and animal health, as compared with the need to lower fiber itself to increase energy in forages. Marketing based upon fiber values has the advantage of simplicity, but may fail to differentiate important differences in forage quality within a critical range where the change in price due to fiber value is dramatic.

## SURVEY OF NUTRITIONISTS

A survey of professional nutritionists was conducted in October-November, 2011, with the cooperation of the ARPAS (American Registry of Professional Animal Scientist) group – California and Pacific Northwest chapters. The reason for doing this survey, was to collect a sampling of attitudes and views of forage quality measurements and how those can be used for evaluating, pricing, and marketing of forages. “Markets” are the sum collective demand of many

individuals, who often differ in their preferences, but nonetheless create a demand signal which must be satisfied by the producer.

Those market preferences may or may not be closely tied to scientific principles of animal nutrition. Thus, if hay exporters wish to have ‘long seed heads’ on timothy, or a buyer wants ‘pink-looking’ sudangrass hay, or ‘pea green’ alfalfa, or an RFV of 175 (but not 172), a TDN of 56 (but not 55.5), these are the realities of the market, and the grower must pay attention. There certainly are aspects of markets which ignore scientific principles of animal nutrition and simply buy hay based upon habit, long-standing (but wrong) biases, or perceived ‘quality’ to the human (not necessarily to the animal).

However, trained nutritionists are clearly in the driver’s seat for any marketing system which aspires to a close relationship between quality factors and animal performance. In most modern larger dairies which buy their feed, the nutritionist is the one who makes the recommendation, not the dairy manager. They then must prove their mettle, measured by the milk tank or daily gains. Thus, determining the usefulness of various measurements in the prediction of forage quality, as judged by nutritionists, should be useful to determine marketing strategies.

The survey was conducted via an on-line questionnaire, and we had 34 respondents. These were essentially all professional nutritionists, with some academic nutritionists. Since we did not have a complete listing of all nutritionists in the United States, this cannot be considered a sampling of all nutritionists, and was biased towards those who chose to respond, and to those primarily in the western US. We had responses from AZ, AB, CA, ID, MT, OH, OR, WA, and WI. Almost all the respondents reported that they advised on animal nutrition issues and ration balancing well beyond their home state, usually 3-4 states. The average number of animals reported to be serviced by this group was 62,198 each, primarily dairy animals, but some worked with beef herds, grazing, and some with non-ruminants (swine).

This survey is meant to provide some guidance as to the ‘sum total’ views of nutritionists’ views of testing and markets, with the aim of arriving at a consensus view of what might be most important for marketing hay and forage crops.

## RESULTS

The results of this survey are provided in Tables 1-4, and Figures 1-2. In general, there are some areas of both good agreement and wide divergence between nutritionists. Here are some of the important findings:

**Lab Testing and Standardization.** Nutritionists tended to use a small number of labs (1-4) (see Table 1). They also often use some labs for specialized purposes. A majority (59%) felt lab standardization was a problem for them, while 41% felt that it wasn’t (presumably, their labs are performing well). Most were familiar with the National Forage Testing Association (NFTA, which standardizes forage testing in the US—see [www.foragetesting.org](http://www.foragetesting.org)), but some were not, with nearly 20% not knowing what NFTA certification means. It was revealing that 40% of respondents felt that NFTA certification was NOT an effective means of determining accurate lab results on routine samples, and 0% felt unequivocally that it was. Forty percent of

respondents felt that it was, but that improvements were needed (Table 1). Clearly NFTA has some challenges ahead (note: there is no government certification of labs in the US – NFTA certification is voluntary certification with standards set by industry members, labs, and USDA and University board members). There was some preferences by nutritionists for wet chemistry methods (39% either somewhat or strongly favored wet chemistry), but a majority of 55% felt that both NIRS and wet chemistry methods were acceptable as long as the data was good.

### **Lab Testing and Marketing of Alfalfa Hay (See Table 2).**

- Nutritionists felt that >80% of the nutritional value of alfalfa hay should be based upon lab tests, <20% based upon visual evaluation.
- A majority of respondents favored using forage quality data based upon 100% DM basis, a minority at 90% DM basis (note – the 90% standardized data is simply the 100% DM basis data multiplied X 0.9. – it came into being since hay equilibrates at about 90% DM)
- A majority of nutritionists favored using an actual measured value vs. a calculated value for marketing of hay.
- A majority of nutritionists ignore the most common marketing tools (RFV, RFQ, and TDN), and 76% of respondents wither use a combination of calculated & measured values, or only a combination of measured values.
- While some (34%) felt that of existing methods, RFV and TDN best reflects the feeding value, a larger number (38%) use other methods, or felt that those calculated values don't reflect the true feeding value of alfalfa hay.

### **Developing a national standard for marketing of alfalfa hay (see Table 3).**

- Although 26% did not feel it was necessary, 32% favored the development of a national standard for marketing hay, and 42% thought that maybe it was a good idea, depending upon the way it was done.
- If a national standard were to develop, few favored using our current TDN, RFV or RFQ calculated values, whereas a greater number (57%) favored using a combination of analyzed values, or (30%) to use a new TDN or calculated value based upon a nationally-recognized summative equation.
- A large majority (82%) felt that a digestibility estimate (NDFD or IVDDM) would be helpful in marketing of alfalfa, but most of those recognized the importance of lab standardization to digestibility measurements, and recognized lab variation as being important.
- There were a wide range of comments about what measurements would be useful in determining the value of alfalfa hay, reflecting a diversity of views (Table 4). However, several have mentioned different types of digestibility estimates.

### **Sampling of Alfalfa Hay (Table 3)**

- Most (70%) recognized the importance of sampling as a major problem in the marketing of alfalfa hay.
- Given this, it was somewhat surprising that a minority of respondents (39%) knew about the free on-line certification for hay sampling available to the industry, and fewer still (189%) had taken the free on-line exam.
- **Note:** Over 1,000 people have taken the on-line hay sampling quiz and are certified as hay samplers. The test has been active since 2002, and the latest to take the exam did so

in November, 2011. See [www.foragetesting.org](http://www.foragetesting.org) for a link to this exam and sampling protocols.

**What is the highest priority measurement for evaluating alfalfa hay (Figure 4)?** This is a key aspect of this survey, since it gets to the issue of what (small) set of analyses might be most useful in marketing. Nutritionists were asked if they were to choose only one analysis to characterize the feeding value of alfalfa hay, what would it be? They were then asked for the second most important, third, etc. Here is what they said (see Figure 4):

- The two fiber measurements ADF and NDF were considered the highest priority measurements for alfalfa hay, with ADF slightly nudging NDF for the first spot, and NDF edging ADF in the second rank. However, if you combine the first two rankings, the majority of respondents ranked a fiber measurement either first or second (Figure 4).
- Crude Protein was a clear choice for the second most important measurement, second only to a fiber measurement (NDF OR ADF).
- There was a high degree of variability in the third, fourth, and fifth choices for lab analysis of alfalfa hay, but NDFD and/or IVDDM (digestibility estimates) ranked very well in the third spot.
- In terms of total frequency, CP was most frequently cited (28 times), followed by NDF (25), NDFD (22), ADF (21), Lignin (21), IVDDM (17), Ash (15) and Other (13).
- The ‘other’ category was quite interesting – and many of the preferences of respondents can be seen in the written comments (Table 4-5). This illustrates the many viewpoints of nutritionists.

### COMMENTS ON CORN SILAGE

It is likely that a very small minority of the corn silage in the US is marketed between farmers, and even less is marketed based upon quality traits. Thus, the experience of the industry of marketing corn silage based upon quality is still in its infancy. The majority of corn silage is grown by dairies and fed on-farm-but this is changing as farm units increase in size; more corn silage is likely to be marketed in the future.

Currently, growers of corn silage who sell to neighbors typically prioritize yield factors over quality, and will often compare grain yields with potential silage yields to determine price. But from the feeding perspective, there is quite a bit of interest in improved genetics (such as the BMR trait, leafy corn varieties, low lignin, and high oil silage types) and how these will affect animal importance.

***Our survey respondents reported the following:***

- DM is very important to both quality and yield estimations of corn silage
- Starch is the single most important analyses, if only one analysis were made
- NDFD is the second most important analyses.
- NDF itself was ranked very high as perhaps the third most important
- DM, IVDDM, Ash, other analyses become important after these.
- Fermentation characteristics become important for judging quality after silage making, along with subjective evaluation (smell, etc.)

- 97% felt that corn silage should be marketed based upon quality, but a large number of these (47%) felt that it was important, but that there were problems with exactly how to do it.
- 97% felt that Corn silage quality should be based upon 100% DM basis.
- 48% either somewhat or strongly (33%) favored wet chemistry methods, and 42% had no preference.

It is obvious that improved marketing methods for corn silage will need to be divided into marketing of the 'Crop in the Field' vs. marketing 'Corn Silage Delivered'. The requirements for these are likely to be different. It appears that widely used measurements of DM, NDF, Starch, CP and NDFD are likely to play important roles for both types. For 'Corn Silage Delivered', additional factors such as 'success in fermentation' – particle size, presence of mycotoxins or spoilage, nitrates are likely to play a more important role.

Moisture content is a critical value, since 'true tonnage sold' can only be determined by accurate moisture percentages. This is sometimes done sloppily. In the case of hays, DM should primarily determine tonnage, not quality. However, with silages, DM may be a major predictor of quality.

It is painfully obvious that there is a need for improved incorporation of quality measurements in the marketing of corn (and other) silages to take advantage of the improved feeding value of improved corn silage hybrids and better methods of ensiling. Utilizing corn grain values alone ignores the significant differences in fiber digestibility that are known to exist between hybrids and growing conditions, as well as ensiling methods. DM, NDF, Starch, CP and NDFD are all likely to play an important role, with physical and chemical considerations also coming into play.

Table 1. Nutritionists' views of laboratory testing (UC survey, November, 2011)		Frequency of Answer
Questions		
Question 1. How many Labs do you currently use? (check any that apply)		
Primarily one Lab		21%
1-2 Labs Only		17%
3 or more Labs		19%
Whatever my client wants		0%
I determine the lab that is to be used		17%
Use some labs for some purposes, other labs for specialized purposes		26%
Question 2. Is standardization of laboratories' results (lab-to-lab) a major problem for you?		
Yes		59%
No		41%
Question 3. How important is laboratory certification by NFTA (National Forage Testing Association)?		
I don't think NFTA certification is important at all		3%
Somewhat important		35%
Very Important - I only use NFTA certified labs		53%
I don't pay any attention to NFTA certification		9%
Question 4. Are you familiar with what NFTA certification means?		
No, not really		19%
I have reviewed the NFTA website and understand what certification means		54%
I interact closely with laboratories and understand what NFTA means		27%
Question 5. Do you believe that NFTA certification is an effective means of determining accurate laboratory results on routine samples?		
Yes		0%
Yes, but improvements are needed		40%
No		40%
Not Sure		20%
Question 6. Which laboratory methods do you favor to determine feeding value of alfalfa hay:		
Strongly favor wet chemistry		18%
Somewhat favor wet chemistry		21%
Have no strong preference - both NIRS and wet chemistry methods are fine, as long as the data is good		55%
Somewhat favor NIRS		3%
Strongly favor NIRS analysis		3%

Table 2. Nutritionists' views of testing of alfalfa hay (UC survey, November, 2011)	
Questions	Answers
Question 1. Alfalfa hay has quality characteristics that aren't easily measured by labs (weed content, molds, etc). In general, what percent weight should be given to laboratory measurements to determine the feeding value of alfalfa hay (Give a percentage, for example: 50%, 70%, 0%, 90%, 100%, etc.)?	
Average Percentage of respondents:	81%
Question 2. When you compare hay lots to determine which to buy, do you look at data adjusted to 100% dry matter basis, as-received basis, or 90% DM basis?	
100% DM Basis	76%
90% DM Basis	24%
As Received Basis	0%
Question 3. Is it better to use a calculated value (e.g. RFV, TDN) for the marketing of hay, or the actual analyzed values (e.g. NDF, CP)?	
Actual Analyzed Value(s), for example NDF, CP, NDFD, ash	75%
Calculated Value, for example TDN, RFQ, NEL	25%
Question 3. Hay is primarily marketed in North America using calculated values of RFV, RFQ, and TDN. Also included on reports are analyzed values (DM, NDF, ADF, NDFd, CP, etc.). What best fits your use of these numbers in judging the feeding value (and price) of alfalfa hay?	
I primarily use RFV for my evaluation	6%
I primarily use TDN for my evaluation	6%
I primarily use RFQ for my evaluation	3%
I use a combination of several values - using both calculated values and an analyzed values (e.g. NDF, CP, TDN, NEL)	61%
I ignore the calculated value and use a single analyzed value, for example lignin or NDF	0%
I ignore the calculated values and use a combination of analyzed values (e.g. NDF, CP, NDFd)	15%
I ignore lab analyses and use primarily field information (e.g. location, cutting) for evaluation	0%
Other (describe below)	9%
Question 6. Which calculated indexes for marketing of alfalfa hay (RFV, TDN calculated from ADF, RFQ) best reflects the true feeding value of alfalfa hay? (what best reflects your views?)	
RFV does	24%
TDN does	18%
RFQ does	9%
NEL does	0%
They all work equally well	0%
They are OK, but I use other lab measurements	30%
None of them really reflects the true feeding value of alfalfa hay	18%

**Table 3. Nutritionists' views of testing of alfalfa hay analysis in relation to marketing and sampling (UC survey, November, 2011)**

Questions	Answers
Question 1. Would it be useful to have only ONE nationally-recognized standard for marketing of alfalfa hay?	
Yes, it would help	32%
Maybe, depends upon how it's done	42%
No, not necessary	26%
Question 2. What is the best option?	
Use existing RFV index	7%
Use existing RFQ index	3%
Use existing TDN calculation	0%
Use a single Lab Analysis, for example NDF	3%
Use a combination of lab analyses (e.g. NDF, NDFD, CP)	57%
Use a new TDN or calculated based upon a widely-used nationally-recognized sum	30%
Question 3. Is it a good idea to use digestibility data (NDFD or IVDDM) for marketing of alfalfa hay (choose the answer closest reflects your view)	
Yes, it helps to differentiate quality	16%
Yes, but labs need to work on standardization	66%
No, the lab analysis is too variable	6%
No, there is not enough biological variation compared to analytical variation to make it useful	13%
Question 4. Is sampling of alfalfa hay a major problem in the marketing of alfalfa hay?	
Yes	70%
No	30%
Question 5. Are you aware that there is a free on-line certification for hay sampling at <a href="http://www.foragetesting.org">www.foragetesting.org</a> to help standardize sampling?	
Yes	39%
No	61%
Question 6. Have you taken the on-line exam and urged your clients to do so?	
Yes	18%
No	82%

**Table 4. Additional written comments by Respondents related to marketing of alfalfa hay.**

**Question: What evaluations of alfalfa hay that might be valuable to you that are not currently widely used in lab hay testing? (comments taken verbatim from respondents).**

Visual appearance and smell
30 hour NDF digestibility
peNDF or some kind of physical measure describing the stem characteristics
ME determinations
Mold count, weed count, effective fiber value
Lignin:ADF ratio
Mycoxins, nitrate, lignin
NDF effectiveness
No single analysis is most important in determining feed value!
The fermentrics information looks promising. Gas production.
Better digestibility values
Indigestible NDF
Hays ability to be chopped up in wagon

**Abbreviations:**

ADF = Acid Detergent Fiber  
NDF = Neutral Detergent Fiber  
NDFD = NDF digestibility  
NFC-Non Fiber Carbohydrates  
CP = Crude Protein  
DCAD=Dietary Cation-Anion Difference  
EE = Ether Extract (fat)  
TDN = Total Digestible Nutrients  
IVDDM = In Vitro Digestible Dry Matter  
RFV = Relative Feed Value Index  
RFQ = Relative Forage Quality Index  
RUP = Rumen Undegradable Protein  
ME = Metabolizable Energy  
NE = Net Energy  
NEL = Net Energy for Lactation  
NFTA = National Forage Testing Assoc.

**Table 5. Additional written comments by Respondents related to marketing of alfalfa hay.**

<b>Question: How do you think alfalfa hay should be marketed (priced, valued)? (comments taken verbatim from respondents)</b>	
	Market determines price when dairy, export, and feeder hay are compared. The hay brokers play a huge role in setting value. What do they base value on? Can they define or understand NDF, IVDMD, lignin etc.? We can advise client whether a good buy relative to other offers. I don't think hay cert. labs, or nutritionists will change those facts.
	I put the analysis into my ration balancing software and run parametrics.
	TDN was recognized in the 1860's to be an invalid measurement of forage quality. In most of the world energy based systems replaced digestible nutrient based systems 100 years ago. The only reason Lofgreen and Meyer used TDN in their equation was because that was the feeding standard used in the US. In fact, DE was more closely related to fiber content of the feed. Any system of feed evaluation should be based on the amount of meat, milk or fiber produced from a unit of that feed and a dollar figure can then be placed on that feed. Any system that is fiber based is inherently wrong. Please discuss with the CA ARPAS people their alfalfa hay study.
	RFV
	According to a relative index that effectively compares one to another
	Based on its true digestibility
	100% DM Basis
	Based on RFV. So much \$/point
	We have adapted our own pricing spreadsheet, attaching values for numerous nutritional quantities.
	By standardized analysis based on multiple factors - ADF, NDF, CP, ASH, DM
	I feel it should be marketed on 4 factors. 1: analysis if the values are trustworthy, 2: visual correlation to analysis, 3: how it feeds out (if the luxury of time is available), 4: a price coefficient for adjusting for variables.
	Free market. If the buyer derives value from forage characterization (i.e., analyses), then the markets will answer the request as long as the value of the information exceeds the cost of acquiring it.
	Based on ndf, energy and protein value relative to other feeds
	Standardized lab analysis. Dry Matter is associated with hauling, Mold and Heating, Bale Type, Location. Other market indices other than quality alone however that were to be defined. e.g. last year RFV 135 hay was selling for about that 135/ton this year same hay same area 210/ton. No quality change but a marketing change unrelated to quality. In that area RFV 200 hay in big squares selling for 250/ton in a round bale 185/ton. Marketing is not all based on quality. Supply and demand in locale, corn price, diesel price.... what drives the base price marketability? Good survey Good questions. Quality needs to be standardized and is important for formulation but marketing is not all based on quality.
	I think that basing it using RFV is ok but it doesn't take into account lignin/digestibility and they need to be accounted for.
	Let buyer beware. How hay actually feeds probably can not be measured by laboratory procedure.
	It should be a combination of NDF, digestibility and crude protein
	quality = price

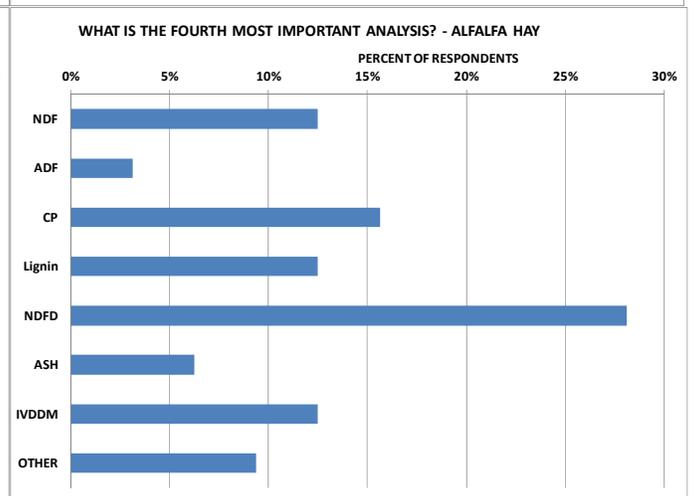
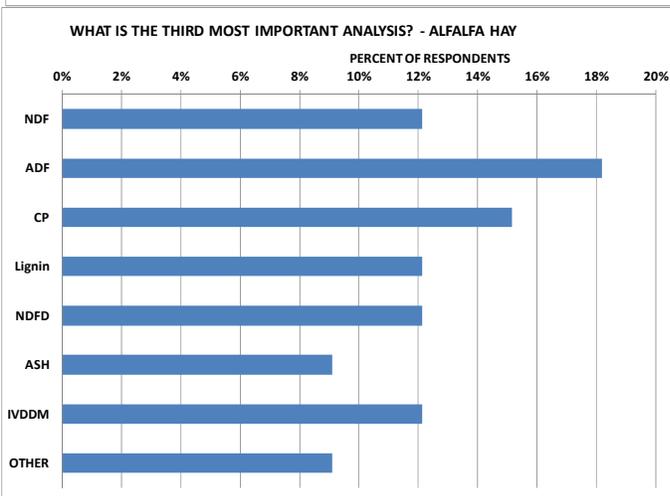
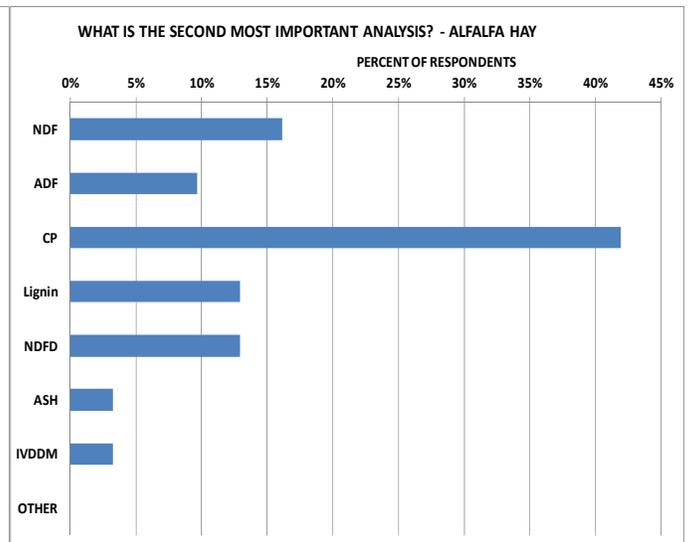
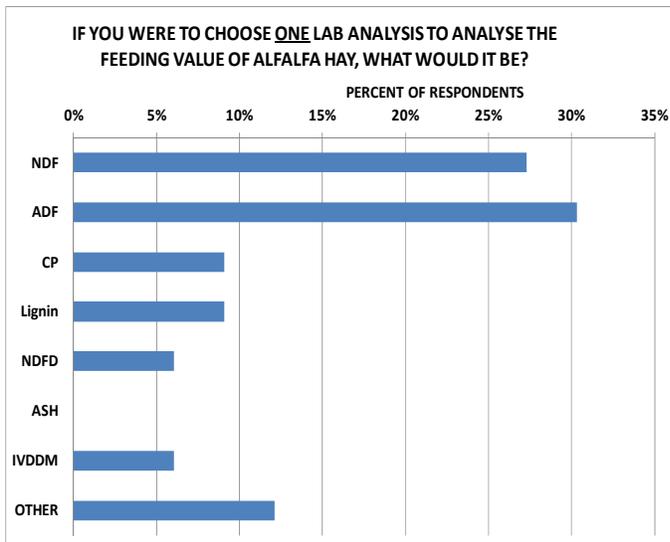
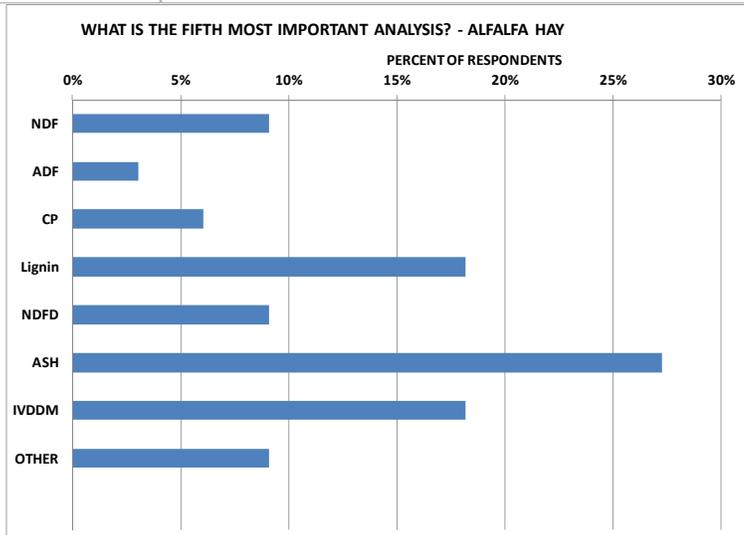


Figure 4. Highest priority, second priority, up to fifth priority measurement deemed important to judge the quality of alfalfa hay – results of a survey of 34 animal nutritionists (Oct-Nov, 2011).



## CONCLUSIONS

The standard hay test consisting of ADF, NDF, CP, and DM has been a standard hay test for several decades, and is the primary set of analyses certified by NFTA. There is clearly a need for change. There is a need to seek ways of improving this system, in particular to prioritize what we measure, and what weight is given to each measurement. This survey indicates that when nutritionists evaluate forages they use several analyses, not just one. This should not be surprising – quality evaluation of practically anything is in a true sense multi-factor problem, since forage quality has many attributes. The predictability of the hay measurement, or series of measurements, must be balanced with the need for the system to be simple and repeatable. This may result in a revised ‘standard hay test’ (Table 4), which also has been previously proposed. All measurements and calculations should be on 100% DM basis and DM analysis should be used primarily for determination of tonnage, not quality. This consists of several lab measurements, which can be interpreted directly, as well as some calculated values which may gain (or wane) in favor, depending upon use (Table 6). The two key features of this proposed set are to: 1) drop ADF as the key measurement, which is currently used for marketing, depending more on NDF, 2) adding NDFD, which is a biological assay. These are not without challenges. A convincing case for the continued measurement of both ADF and NDF for marketing pure alfalfa hays has not been made, and nutritionists generally favor NDF (more frequently cited). Although there remain sometimes severe differences of opinion between nutritionists about what is most important (see survey results, especially Table 5, this represents as close as possible a ‘consensus’ view of what is most important for alfalfa hay. Whatever system evolves should be relatively simple, flexible for different classes of livestock, based upon repeatable lab values, and transparent as to origin.

Table 6. Suggested direction for a revised standardized hay test. While a wider range of analyses can be used, this represents a smaller sub-set for ascribing a majority of the value of alfalfa hays. This would replace the current practice of utilizing DM, ADF, NDF, and CP in standard hay tests.

*Analytical Determinations (all on 100% DM basis except as indicated)*

- Dry Matter (DM) (as received)
- Neutral Detergent Fiber (aNDF) (100% DM)
- NDF Digestibility (NDFD) (100% DM)
- Crude Protein CP (100% DM)
- Ash (100% DM)

*Calculated Values (100% DM) as Needed*

- TDNn (based upon a nationally-recognized summative equation utilizing the above analyses)
- NEL, ME, RFV, RFQ, TDN as needed

Table. 7. How do you think Corn silage should be marketed?	
	it would be nice to have a nationally standardized test that all labs would perform in a set sequence with a known amount of chemicals, time, etc. then sell that test to arpas nutritionists to use.
	As a grower, I want the silage evauated before it goes into the pit. That is a great deal of testing with little value other than setting a price. As a nutritionist, I only want to see tests after the product is fermented because that is then product I get to work with. In either case, the dairyman seldom gets the oportunity to turn either product away because of the analysis. He can olny chnage the price and the amount he feeds.
	Data is plural, see comments on alfalfa
	Value based on DM, Starch, NEL3x and NDFdig called the Corn Value Index delveloped at PDS
	First, price should always be corrected according to the DM of the silage. Second, some quality measure such as starch or NDFD should be used to rate silage quality and a price should be determined according to that measure.
	it should be marketed nd priced based on the dm content it's digestibility.
	I deal with so little corn silage in my area that I really have not formed any opinion on how it should be marketed. I just use whatever nutrient values I have available to me.
	Currently all corn silage regardless of quality seems to be sold at the same price. I use the milk 2006 program to compare corn silages.
	100% DM Basis and sold off of a combination of CSPS and Starch values
	Processing Score of the Corn
	we use a custom pricing spreadsheet, attaching values for numerous nutritional quantities with emphasis on units of available starch and units of digestible NDF
	Adjusted to a DM basis and based on several standardized analytical factors DM, ADF, NDF, ASH, Digestibility/Fermentation Index
	a base price based on corn price, then adjusted accordingly via DM%, analysis results, corn content, sugar content, TDN, whether processed or not, mycotoxin screen, treated or not & w/what, variety/age
	DM basis
	Free markets. Same comment as above.
	On quality as determined by ash, starch, NDF content, estimated NDF digestibility, and low levels of molds and mycotoxins.
	first based on DM (discounts for dry and wet silage) then on calculated energy
	DM is huge if any transport is involved compared to dry feeds. Fiber digestibility and energy content (e.g starch) would be next. Then probably some preservation characteristic to note how stable the silage is so that could be pH, VFA, Molds, Yeasts, Particle size, NIR picture.
	Should be based on a DM and starch content.
	based on ndf digestibility and/or starch and of course, dry matter. Fermentation characteristics are important but I don't use lab analyses to determine. I use visual, smell, moisture etc.
	We look at DM first (main price component). Starch and NDFd are pretty important.
	by more than just weight alone
	As an energy source, so NDF and starch content and their digestibility are crucial - processing and particle size play a big role in thins
	1st-moisture corrected2nd-on a scale of quality

Table 8. General Comments on Forage Testing and Marketing.

<p>national NIRS testing without local corrections leaves too much error in the analysis. using alfalfa equations to determine the energy of grasses, forbs, and straws is a carryover from 50 yrs.</p>
<p>Since not all fibers are created equally, then fiber based analyses will be biased. The CA ARPAS approach is, in my opinion, an improvement on existing methods. It has been shown that, for either RFV or RFQ, neither ADF nor NDF are correlated with digestibility nor intake and that RFV(est) has an <math>r^2</math> with RFV(act) of about .05. It's time to move forage testing away from the 1800's and into the late 1900's. This will happen if and only if we quit using fiber based analyses. They are simple, cheap and wrong.</p>
<p>Forage analysis is extremely important to ration formulation. Establishing a sampling schedule and monitoring changes in forage quality can help prevent production and health problems in dairy herds. Accurate sampling and analysis is very important to make this system work.</p>
<p>It's important to find a lab that you are comfortable with. Are the lab results close to what I expected? If yes, then that gives me confidence.</p>
<p>More importance should be placed on standardization between labs, even NAFTA certified labs.</p>
<p>while i believe there is a great need to standardize, too many believe without the standardization they have the ability to make a better deal because of ignorance concerning the other party involved. ie, they can sell a lower quality crop for more than it is worth or vice versa they can buy an excellent crop for an average price.</p>
<p>I feel any analysis is beneficial if the results are accurate, (<math>^{adf w/^{tdn}}</math>), or unrealistic. as the example. I feel it doesn't matter which lab you use, as long as it's the same lab for relativity. \$'s paid, results realized, and reputation are dependant on testing to provide accurate info to reduce risk.</p>
<p>Any improvements in analysis will only succeed with a significant Educational effort of the end users.</p>
<p>IVDDM and IVNDFd have very poor correlations with either in situ or in vivo measurements. They are moderately useful in a qualitative ranking of quality, but they are entirely useless in determining degradation rates for ration formulation software.</p>
<p>As our grain supplies are continually being dedicated to other uses our ruminant animals can excel in utilizing good quality forages. The forage producers need to understand the difference between quantity and quality and where their line between input vs saleable output crosses. Lab standards need to be in place with good quality results and ease of accessing the results. We are achieving milk production and weight gains in cattle with high quality forages that some would say we could never do but thanks to plant genetics and farming practices we are doing it. Big picture is our cows are 4 inch sickle bars and automatic manure spreaders they were built to utilize forage so thanks for helping the industry make that happen. Good Job Gang! Happy Thanksgiving.</p>
<p>I think there is a major problem with small regional labs that have NAFTA certification putting out values that are not accurate. Especially in values such as Lignin and NDFD as they just don't do enough samples. These labs tend to make hay look much better than it really is. Hay growers are using these labs to get a better value for their hay.</p>
<p>Forage analysis is extremely important to purchasing and utilization on dairies. Standardization is a huge problem with labs. I only use 2 labs in order to minimize this problem.</p>
<p>standardization of forage analysis is very important to the objective marketing of forages</p>
<p>Replicated results are crucial for evaluating quality and value. Basing nutritional or purchasing decisions on a single sample or analysis is risky</p>