NDS Features: Evaluating Rumen Fill When Formulating or Troubleshooting Rations

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Establishing high intakes (**DMI**) is important for high production and to facilitate higher forage rations. However, either too much forage or low digestibility forage can reduce DMI due to a rumen fill effect. NDS has two features helpful for guiding ration reformulation or troubleshooting performance issues related to intake limitations or forage changes. These two features are the cell showing uNDF as% BW, and the new "Rumen Fill" tab.

DMI is closely linked to undigested feed residues in the GI tract (Conrad 1966). After development of the neutral detergent system, NDF intake was considered the best predictor of DMI in ruminants (Van Soest, 1965; Waldo, 1986). Mertens (1987) suggested that NDF intake at 1.2% of bodyweight (BWT)/day would be the most accurate predictor of DMI in dairy cows. For years, many field nutritionists used that benchmark as an indicator of DMI capacity. Mertens (1987) assumed that all NDF sources influence intake similarly. However, he also stated that further research was needed, and that information about lignin content, digestion kinetics, particle size, fragility etc. would improve DMI predictions from NDF. The importance of these other factors was later emphasized by Allen (2014) who said "Dramatic differences in voluntary DMI have been observed for fill limiting diets of the same NDF content, indicating that the filling effect of NDF is variable."

The impact of these other characteristics of NDF became clear to me about 10 years ago when I observed that when rations included BMR corn silage NDF intake was significantly higher than Mertens' prediction. Presumably NDF intake was increased because BMR NDF is highly digestible; I guessed that intake limitation on BMR silage would be related to indigestible NDF, not total NDF. CNCPS used lignin x 2.4 as an estimate of indigestible NDF (**iNDF**) at that time, and I arranged for diet iNDF (expressed as %BWT) to be added to the ration evaluation screen. Then, after evaluating many diets I observed that iNDF as a %BW remained much more constant than NDF as a % BW. When highly digestible forages were fed, NDF intake exceeded Mertens' estimate, and NDF intake would run up as high as ~1.45% BW or more, while iNDF was more constant across forage qualities, and remained ~ 0.33% BW. Thereafter, when I formulated or did ration troubleshooting, I paid more attention to the iNDF %BW than the NDF %BW, and this worked well. At the first NDS training session I attended as an NDS user, I requested, and NDS developers agreed to implement, iNDF% BW on the NDS ration screen. In NDS the cell expressing uNDFI %BW is located on the left side of the main ration screen about

Intake	Check DMI	Forages/Concentrates	Rumen fill	Other items			
As Fed tot.lbs		128.623	**DMI tot.lbs**		57.344	F 51.59%	
Wgt TMR lbs		128.623	**DMI TMR lbs**		57.344	C 48.41%	
DMI pred lbs		57.958	-0.61 (98.9%)	4.17 %BW		44.6%	
DWI pred lbs		218.879	**uNDFI %BW 0.35%**	**NDFI %BW 1.22%**		0.88%	

midway down on the "Intake screen".

"uNDFI" means "undigested NDF Intake", and is calculated from the intake of uNDF240 for forages, and uNDF120 for concentrates. The amount of NDF residue (**uNDF**) at these times is presumed to be indigestible, and therefore an estimate of iNDF. NDS calculates this using the appropriate time points from laboratory analyses. For feeds which do not have analyzed three time point digestibility values, lignin x 2.4 is used instead, as was used in previous CNCPS versions.

When the lignin x 2.4 estimate was used prior to CNCPS 6.5, uNDFI %BW typically ranged from 0.30 to 0.35, mostly centered around 0.33 %BW. The new three-time point assay usually gives a modestly higher estimate of uNDF compared to lignin x 2.4, so with the new system, the values are expected to run ~0.35 to 0.40. We are presuming this range from limited empirical experience, although in practice, it seems to be reasonable. Hovering the pointer over the green cells on the screen shows the expected ranges. The range for the NDFI %BW is a skewed slightly higher than Mertens' 1987 estimate, probably consistent with use of more digestible forages than 30 years ago.

At actual consumed DMI, if uNDFI exceeds the upper end of the range, it strongly suggests that the ration is limiting intake because of gut fill. If the value is below the expected range, it suggests intake is being limited, but by something other than gut fill, likely something from the chemostatic regulatory system, such as low rumen pH or high acetate silage. When troubleshooting a ration, I look at the uNDFI %BW value early in the process to assess if intake might be limited. Also, I always assess uNDFI %BW amount before I finalize a ration.

NDS has also implemented a new feature to help assess gut fill, the "Rumen Fill" tab, located to the right of the "intake" tab at the mid/lower left side of the recipe screen. We will describe its use in the next NDS Dynamics Newsletter.

NDS News: We are pleased to announce that Dr. Pedro Melendez is joining the NDS-NA team:

NDS-NA is very pleased to announce and welcome a new team member, Dr. Pedro Melendez. Dr. Melendez will provide NDS support in South American countries and to other Spanish speaking countries. He can help with emails, and looks forward to getting some training sessions done in South America. He is using the software in his consulting already and has used the software in his presentations in various countries. NDS is used by dairy nutritionists worldwide, and is available in six languages,, including Spanish. Dr. Melendez will be a great asset to NDS users.
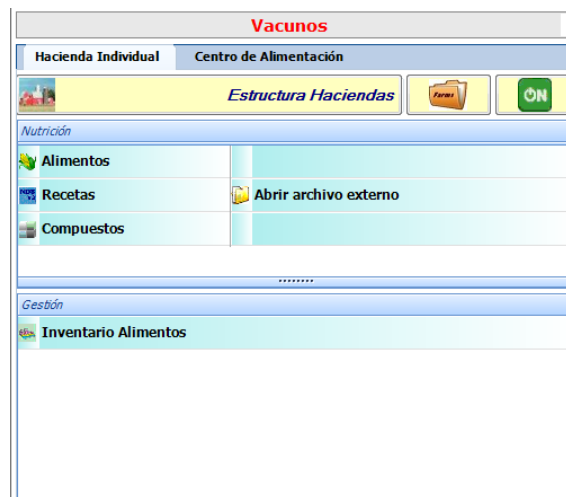
Dr. Pedro Melendez: Brief Bio:

Dr. Pedro Melendez is a native veterinarian from Chile who earned his professional degree at the University of Chile in 1990. In 1997 he began his residency program and master's degree in Cattle Production Medicine at the University of Florida, USA. In 2001 he obtained his master's degree and in 2004 his doctor's degree (PhD). Also in 2004 he obtained the position of Assistant Professor in the College of Veterinary Medicine, University of Florida. In 2008, he decided to return to Chile to work as part-time Professor at the University Santo Tomas and consulting for 12 dairy farms in the area of Production Medicine and nutritional management. For this purpose, Dr. Melendez worked using the ration formulation computer program CPM. In 2015 he decided to go back to the USA, obtaining the position of Associate Professor at the College of Veterinary Medicine, University of Missouri. In this new challenge Dr. Melendez made

contact with the company Management & Nutrition Ruminant to start exploring the ration formulation program NDS Professional, which uses as a base the Cornell nutritional model CNCPS version 6.5. Dr. Melendez utilizes this software in his academic and research duties at the University of Missouri and for nutrition consulting in dairy herds from Chile, Argentina, and Uruguay.

An NDS Assessment from Dr. Pedro Melendez:

 I am an Associate Professor at the College of Veterinary Medicine, University of Missouri. Since March 2015 I have been using the software NDS Professional on my research and teaching program, In addition, I have been working on the nutritional program of the University of Missouri Dairy Research and Teaching Unit (Foremost Dairy) formulating diets with the NDS professional software. Unquestionably, as a follower of the Nutritional Cornell Model (CNCPS), NDS professional has the major advantage of being a very friendly software, with periodical automatic updates, offering very precise predictions of milk performance of dairy farms. In addition, it has a very interesting feature on the topic of fat nutrition based on Dr. Thomas Jenkins model. Furthermore, the IT and technical service is a highly supportive and knowledgeable team answering questions and concerns within a short period of time. As a veterinarian, the Well-being risk feature is one of the strength of this program by predicting ruminal pH, milk fat %, milk urea nitrogen, risk of hypocalcemia, etc. In addition, the economic breakdown of the diets, allows me to response the questions that always farmers ask to any nutritionist regarding feed efficiency and cost analysis. Moreover, nutritional analysis results from laboratories offering the CNCPS platform can be downloaded directly to NDS professional feed library without the necessity of typing or entering individually each analysis.

In conclusion, as a veterinary and animal science teacher, researcher and consultant, NDS professional software offers me an updated version of the CNCPS (Cornell Model) with an extremely friendly diet formulation and nutritional evaluation approach.

Pedro Melendez, DVM, MS, PhD
Associate Professor, College of Veterinary Medicine
University of Missouri

Welcome Dr. Pedro Melendez, DVM, MS, PhD

Note that the features and utilities developed by the NDS team described above are not components of the underlying CNCPS model, and do not change the model outputs or results. _Questions about use of these features should be directed to the NDS support team, and not to the CNCPS group at Cornell._