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NDS Dynamics

CNCPS Biology adjustments – CNCPS v6.55

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NDS is an evolving platform and it is continuously updated, as the results of new research is available, and as the updates of the biological model are released by Cornell University. This happened in the fall 2014 with the inclusion of the CNCPS v6.5 biology, and it happens again now (January 2016) with adjustments provided by the **CNCPS version 6.55**. With the release of the CNCPS v6.55, the Modelling Group at Cornell made some changes on the passage rate area and fixed some issues on amino acid calculations.

Changes have been made to the prediction of the rumen passage rate for forages and it represents the most important adjustment in the CNCPS biology because the passage rate equation change for forage is quite significant. That is the reason why the Cornell Modelling Group decided to call this version as CNCPS v6.55.

In CNCPS v6.5 the forage passage rate is predicted by an equation from Seo et al. (2006) that was built from the same database used to develop the 2001 Dairy NRC (NRC, 2001) equations. More recent studies based on rumen evacuation data demonstrated that the predicted passage rate of forage from that equation is too fast and would therefore underestimate the digestibility of fiber in the rumen. This discrepancy between passage as measured by the flow technique versus the prediction of Seo et al. (2006) was also identified during the development of the most recent versions of the model and alternative passage rate equations were evaluated. Therefore, the equation for forage and fiber passage rates was adopted from the NorFor modeling effort (NorFor, 2011). Concentrate and liquid passage rates were left unchanged, and they remain the same as provided for earlier versions of the model (Seo et al., 2006).

As expected, there was a significant difference in the predicted passage rate of forages between the old and the new equations. In overall evaluations, the Seo equation mean kp prediction was 4.8% h-1, with a range of 1.3 to 7.4 h-1, whereas the NorFor equation prediction was 1.7% h-1. Compared with Seo et al. it is approximately half: 1.2 to 2.9 h-1 less. The predicted decrease in passage from the rumen with the NorFor equation allows for greater rumen mean retention time and thus greater ruminal NDF digestibility and subsequently increased ME and MP supplies. A re-evaluation of the lactating cattle data suggested that ME increases by 2 to 8%; ME was more positively influenced than MP and the change in MP was generally less than 50 g for the average diet.

As with all modifications to the model, there is an offset either downstream or upstream from these calculations that requires modification to allow for proper balance. In this case, the offset is in the intestinal digestibility (ID) of NDF (CHO B3 fraction). The intestinal digestibility of NDF was set at 20% for CNCPS v6.5 and this was done to account for potential hindgut fermentation. However, a review of the literature about the digestion of NDF through the entire gastrointestinal tract suggests that on average, post ruminal NDF digestibility is approximately 5% (Higgs, 2014). Therefore, greater ruminal digestibility due to the adoption of the NorFor equation is now offset by a reduction in the overly high post-ruminal digestibility in CNCPS v6.5, with post-ruminal digestibility now set to 5% in CNCPS v6.55.

Below the comparison of a ration evaluated according to the two biology:

Allowable Milk		CNCPS 6.5	CNCPS 6.55		
ME Allowable Milk	lbs/d	87,85	93,52	5,670	6,45%
MP Allowable Milk	lbs/d	87,18	90,01	2,830	3,25%
ME Allowable ECM	lbs/d	89,18	94,94	5,760	6,46%
MP Allowable ECM	lbs/d	88,49	91,37	2,880	3,25%
AA Allowable Milk	lbs/d	63,90	66,40	2,500	3,91%

In some cases, such as the above example, the increase of Allowable Milk may create some concerns about the accuracy of the model when the diet is evaluated according the CNCPS v6.55. Under these conditions, **in order to maintain high level of accuracy, it becomes of primary importance to accurately evaluate and input the energy balance and the expected changes of BCS.**

The recipe in the above example was evaluated without considering any BCS change even though, in this case, cows are in positive energy balance.

BCS (1-5)		3,20	BCS 30d 3,39	BCS 60d 3,57	BCS Dry Off 4,06
Target BCS		3,20			
Days to reach target BCS	days	100			Days to Dry Off 147

For a better evaluation of the body reserves changes expected, NDS now shows, next to the current BCS (Animal Inputs screen), the projections of BCS, or BCS expected in a short (30 days), medium (60 days) and long term (at dry off).
Thanks to this addition, it becomes easy to change Target BCS according the expectations, for example, in short terms (3.39 after 30 days):

BCS (1-5)		3,20	BCS 30d 3,39	BCS 60d 3,57	BCS Dry Off 4,06
Target BCS		3,39			
Days to reach target BCS	days	30			Days to Dry Off 147

This approach gives indications about how the positive energy balance will affect Allowable milk. A new comparison will show closer and better agreement in predictions between the two versions biology:

Allowable Milk		CNCPS 6.5	CNCPS 6.55		
ME Allowable Milk	lbs/d	87,85	87,49	-0,360	-0,41%
MP Allowable Milk	lbs/d	87,18	85,83	-1,350	-1,55%
ME Allowable ECM	lbs/d	89,18	88,81	-0,370	-0,41%
MP Allowable ECM	lbs/d	88,49	87,12	-1,370	-1,55%
AA Allowable Milk	lbs/d	63,90	66,40	2,500	3,91%

The introduction of these significant changes in the biology (forage passage rate and intestinal digestibility of NDF) highlights the importance, and makes even more critical, **the need to account for diet energy balance and BCS changes in order to get good accuracy of predictions.**

We focused on the final diet evaluations given by CNCPS 6.55. However, they are the results of several model aspects. The main ones are listed below:

		CNCPS 6.5	CNCPS 6.55		
CHO B3 degreded	g/d	3.623,64	4.815,59	1.191,950	32,89%
CHO B3 degraded	% DM	14,78	19,64	4,860	32,88%
CHO B3 degraded	% NDF	41,30	54,89	13,590	32,91%

- Increase of the pdNDF degraded in the rumen

- Increase of protein degraded in the rumen with a corresponding reduction of escaped protein

RDP	g/d	2.076,37	2.221,42	145,050	6,99%
RDP	% CP	54,52	58,33	3,810	6,99%
RUP	% CP	1.732,13	1.587,07	-145,060	-8,37%

- Increase of MP from bacteria and reduction of MP from RUP

		CNCPS 6.5	CNCPS 6.55		
MP from bacteria	g/d	**1.320,57**	**1.460,34**	**139,770**	10,58%
MP from bacteria	% MP	**48,92**	**54,04**	**5,120**	10,47%
MP from RUP	g/d	**1.378,71**	**1.242,03**	**-136,680**	-9,91%
MP from RUP	% MP	**51,08**	**45,96**	**-5,120**	-10,02%

- Reduction of MP requirements due to reduced Metabolic Fecal Protein

MP Available	g/d	**2.699,27**	**2.702,38**	**3,110**	0,12%
MP Required	g/d	**2.674,86**	**2.620,13**	**-54,730**	-2,05%

CNCPS v6.5 model has done a good job of predicting ME and MP allowable milk with lactating dairy cows based on most limiting ME or MP, and v6.5 provides a good prediction of total MP supply (Van Amburgh et al., 2015). The new CNCPS v6.55 is expected to provide comparable accuracy.

However, a problem with v6.5 are the evaluations related to dry cows and heifers. ME and MP supplies are being under-predicted in cattle fed high forage diets at more moderate intakes than a high producing lactating dairy cow. This is especially true for dry cows and heifers.

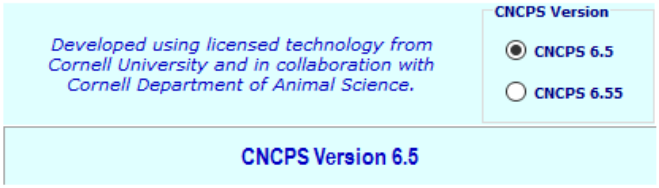
The impact of the change in passage rate prediction was evaluated on dry cows with data from work being conducted at Cornell (Sweeney and Overton, unpublished data). The impact on ME and MP supply predictions for the dry cow diets demonstrated that with the NorFor equation, the increase in ME supply was more consistent with the observed energy balance of the cattle. The adoption of the NorFor equation will reduce the amount of ME supplied to dry cows and minimize weight gain, adiposity and possible post-partum issues.

In addition, some evaluations of growing heifers have been conducted and the updated passage rate equations appear to provide ME allowable gain predictions that are more consistent with the observed growth rates for heavier heifers. The use of CNCPS in the field when inputting rations of high forage % have created heifers and dry cows which often have put on more than desired BCS when compared to the output page of the ration. The use of the new passage rate should help better predict ME to MP ratios when doing growing dairy heifer rations. This will help to give much better predictions than in previous versions, in which best growth results could often be achieved when MP was at 100 to 105% requirement and ME was restricted 5 to 7 %. This approach in the past would achieve growth at or very close to the MP prediction. It is expected that the increased ME supply from forage in v6.55 (arising from the implementation of the NorFor passage rate equations) will better describe the energy available in dairy heifer diets, and result in more accurate growth predictions and minimize excessive fattening.

As mentioned above, this version of the model made also changes in order to fix an amino acids issue. In the previous versions of the model (CNCPS v6.1 and v6.5) information about AA supply or requirements was disconnected from AA in tissue when body condition change occurred; that has now been fixed in v6.55. The changes correct the issue with amino acid supply and requirement when body tissue is mobilized or accreted via a BCS change. In other words, tissue AA are now included in the calculations: when BCS is lost the tissue AA mobilized are added to supply, while if BCS is gained the tissue AA required are added to requirements.

In the NDS update 3.9.1.01 the NorFor equation for forage passage rate is implemented. In addition, user feeds and Master Feed Libraries (RUM&N and CNCPS) are updated in order to get the new intestinal digestibility of CHO B3 (5% of escape) required for CNCPS v6.55. The procedure does not change the ID of CHO B3 for Commercial Feeds included in the Master Libraries, because not enough information are available now, and because the commercial feeds are not forages, and therefore not affected by the forage passage rate that occurs with the new NorFor equations.

In order to allow a soft transition to the new biology, as well as to allow comparisons between the evaluations made by CNCPS v6.5 and those provided by the new CNCPS v6.55, the user could decide which version of the model to use, both as an overall setting (Startup screen) and/or for each single ration (Info Tab of Recipes). The ability to easily and in multiple places switch back and forth between v6.5 and v6.55 should help a smooth transition to the new biology. Two new video tutorials will be available this week to further demonstrate both how NDS allows users to compare results with v6.5 vs. v6.55; and to provide further guidance on formulation under v6.55, especially in terms of attention to energy balance.



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