What happened to my CPM thinking?

a.k.a. Moving from CPMv3 (CNCPSv5.5) to CNCPSv6.1 biology

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Prior to AMTS™, we were working on CNCPSv6. That project officially began in 2002 with the objective of simply re-working the system to become more user friendly. Instead, a whole new model evolved. Between error corrections, new biology, and new thinking, CNCPSv6 forced some questions and debate that started the model down a stronger path. Late 2005, Van Amburgh assumed leadership of the core biology team at Cornell and since then, many more areas within the model have been updated. The resulting biological model (CNCPSv6.1) offers vast improvements in predictability and accuracy with more changes to come. This period of change has altered our interpretations, recommendations, and thinking related to cattle nutrition. For those of us that have been involved with this evolution (I began working with the model in Jan 1990), we are pleasantly surprised and pleased at how the model behaves now. However, we've had time to adjust to these changes. As someone either moving from CPMv3 or evaluating any AMTS™ product, you are seeing changes in predictions that will have you scratching your head trying to figure out which direction to go. It is true that many cows around the world have been fed successfully off CPM just as many cows have been successfully fed using NRC 89, INRA 89, or any other system. Moving to CNCPSv6.1 biology does not have to be daunting. This document is meant to highlight and explain many of the differences between CPMv3 and CNCPSv6.1 predictions.

Let's start with what has changed.

Item	CPMv3	AMTS™.Dairy (CNCPSv6.1)	Impact
Carbohydrate Pools	A1 - Silage Acids A2 - Sugar	A1 - Acetic + Prop. + Butyric A2 - Lactic Acid A3 - Other organics A4 - Sugar	Provides some microbial yield from lactic and other organics
Carbohydrate kds	A1 - 0 %/hr A2 - 300 - 500 B1/2 - 40 - 60	A1 - 0 %/hr A2 - 5 A3 - 3 A4 - 40 - 60 B1/2 - 40 - 60	Lower microbial yield due to less CHO rumen degradation. Old rates were for pure substrate, pure culture *in vitro* whereas new rates are mixed substrate and mixed rumen bacteria *in vitro*
Carbohydrate ID	B1 (primarily corns) as high as 85% for ground corn	B1 (corns) dropped 10 points based on data from Knowlton et. al. and others	Decreases energy content of corns.

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Protein pools	Same pools but pool sizes have changed. PRO A (silages) - NPN >85% of soluble PRO A (others) - NPN 50 - 90%	Silages A dropped to NPNs 40-60% of soluble. Others: NPN 0-25% of soluble	Change in pool size combination of improvements in methodology. Older methods used filter paper with pore sizes too large and incorrect dilution of substrates resulting in over estimations of NPN supply.
Protein kds	A - >10,000%/hr B1 - 100 - 500 B3 - 0.05 - 1.00	A - 100-200%/hr B1 - 40-60 B3 - for forages, tied to the CHO B3 kd. No change for other feeds yet.	Reduces protein degradation and makes the rumen model more N sensitive. Think this way: if A was 10,000%/hr, that means urea would dissolve before being fully in the rumen fluid (time for degradation about 0.36 seconds). Not realistic!
Passage rates		new passage rate equations.	
Pool passage	pools flow with the passage rate of their feed source. e.g. sugar in alfalfa hay flows same as unavailable fiber	Pools flow as follows: PRO A and B1 - liquid passage rate CHO A1-A4 - liquid passage rate CHO B1 with passage rate of concentrates	Increased passage rate of soluble fractions, coupled with lower kds, means that some soluble fractions will escape the rumen. As an example: sugar old rate = 500% and kp of say 6%. This means 98.8% of sugar degrades. New system of 40% kd and 11% kp means 78.4% degrades. That's 20 units lower! That means less microbial yield!!

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Fat Digestibility	Fatty acid model used to adjust energy. However, due to concerns, CNCPSv6 went back to a fixed 95% digestibility for fats.	Calculated as a weighted average of a feeds fatty acid content and fatty acid digestibility coefficients. Assumes 90% digestibility for glycerol and 0 for pigment. Microbial fat digestibility reduced to 80%.	Decreases energy content of diet. As compared with earlier 6.1 biology builds, ME allowable milk decreased 1-3 liters. Closer ME values predicted when compared with measured data.
Feed chemistry--NFC	NDICP added back into NFC and subtracted from NDF in calculations	None of this is done now.	Result is NFC dropping about 3 units. This is all coming from how NDF is analyzed. CPM assumes that NDFs were run withOUT sulfite or amylase. Only one lab was offering this method. All other labs have been using the two and it is closer to the official AOAC NDF method.
Maintenance equations		updated surface area equation and how heat production is calculated.	Heifers are slightly more cold tolerant now.
Ash calculations	Microbial ash ‘magically’ appeared in system	Corrected this error.	Reduces maintenance protein about 100 g/d in lactating cow.

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Rumen ammonia requirements	Disconnected system. If peptides were deficient, no impact on predictions.	NFC bacteria can utilize either peptides (up to ⅔ their N required) or ammonia. If less then ⅔ N required met by peptides, additional ammonia is required.	This was a basic calculation error. However, with about 10 units less microbial yield, never see peptides deficient.
Heifer BW		growth and maintenance and intake were developed from non-pregnant animals. 3rd trimester heifers (heavy with calf) inputted with scale body weights resulted in over-estimation of maintenance (about 10%) and intake. Now, BW is calculated by subtracting calculated conceptus weight from inputted weight.	Reduces maintenance energy requirements of heifers about 10%. Plus shifts the heifers down the growth curve to drive protein requirements up slightly.
Heifer NEm coefficient		Updated biology to calculated 73 kcal/ MBW	A further 10% reduction in maintenance energy requirements.
MP lact efficiency	65%	67% based on NRC 2001	Increased accuracy.

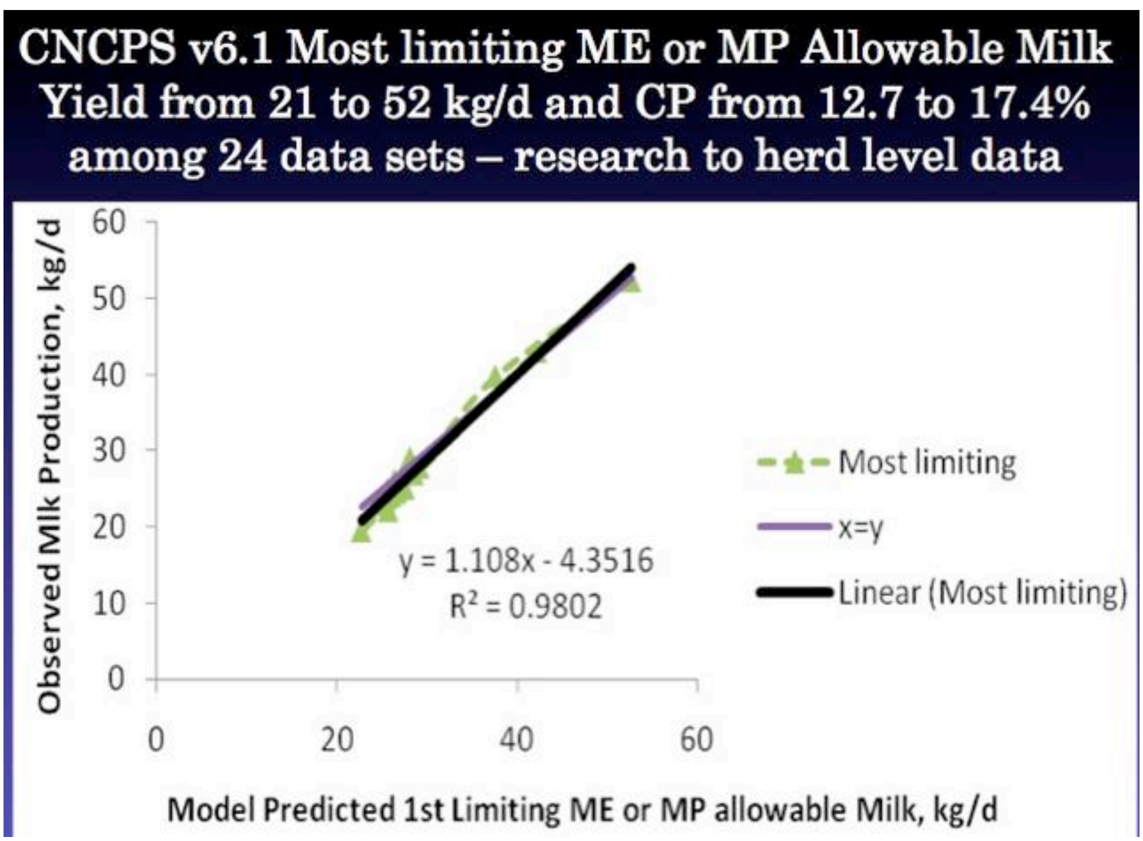
Ok, so what can we expect?

In general, the following shifts will happen to a lactating cow evaluation (CPM base to AMTS™ using the CPMv3 100lb cow session file)

1. ME allowable milk will decrease 3 lbs
2. MP allowable milk will typically increase 10 lbs
3. MP from bacteria will drop from mid-50s% to mid-40s.
4. RUP will increase about 10 units
5. Ammonia balance will increase about 20 units (130 to 156%)
6. Peptides: don't even look at them again!
7. LYS %MP will decrease about 3 units (6.9 to 6.6)
8. MET %MP will decrease about 2 units (2.2 to 2.0)

Which is correct?
That is always the important question. A data-set with 24 published trials was used to evaluate the systems. The bias (how much the model would over or under predict ME or MP allowable milk) dropped to zero. MP allowable milk in this data set was 20 lbs bias for the earlier systems and this bias went away with the updates.

You may ask, *how was there a 20 lb bias when I've used it for years and it has worked great for me*? And it has worked. But what do you do when a prediction doesn't come close? Or did you ever noticed that most diets were always higher in crude protein then they really needed to be? The model is an evolution and this is a big step!



So, how do we reset ourselves?

Here is a big thing to consider. In everything up till now, because of limitations in our knowledge, safety factors were 'built in'. In 6.1 biology, there are NO safety factors. If the model says most limiting milk will be 77 lbs, there is a very high probability actual milk will be between 76.5 and 77.5 lbs. Most of the time even closer! So, if you formulate for 77 lbs, will you be limiting the higher producing cow? Maybe. The whole issue of safety factors and lead feeding must be considered! Safety factors are now in your hands as the nutritionist.

So, here are our current recommendations:

1. Actual DMI should be between the CNCPS and NRC predicted intakes.
2. Ensure adequate peNDF (>22% but can vary based on herd management)
3. Ensure adequate rumen ammonia (>120%). A maximum on rumen ammonia is difficult as it partially depends on which feeds are available. I tend to watch what MUNs are doing and am targeting 8-12 mg/dl.
4. NFC: the model likes fermentable carbohydrates and NFCs are a great source. While we now say 40% is the maximum, depending on the sources and the cows, 42-43% may be acceptable.
    a. Makeup of NFC is debatable. Some people get all worked up that sugar + starch must be x, so much soluble fiber must be fed, etc. For me, I look at what is the most economical source of fermentable NFC and that varies by geographical region. In the Northeast US, it is starch so I will be 28-32% starch. But I will be low sugar (less then 3%) and low soluble fiber.
    b. with no safety factors, availability of the NFC is a bigger concern. Corn that is not degradable doesn't produce microbial protein! More will be coming from this whole starch degradation area in the future!
5. MP supply: remember, we are first microbial nutritionists and then supplement the cow. Select high quality proteins and amino acids.
6. Fat: same recommendations as CPM. Total unsaturates >500 g/d are a risk factor for reducing milk fat. Watch quantity and quality of NDF. I tend to watch unsaturates %diet DM and target <3%.
7. Amino Acids: If you are going to formulate for amino acids, 6.1 biology tells us:
    a. Make sure MP balance is positive
    b. Make sure all (or majority) of amino acids are >=100% required by factorial calculations
    c. LYS %MP >6.4
    d. now, if I am formulating for maximizing milk protein, I will meet LYS and then bring in MET until the LYS:MET ratio is between 2.8 and 2.9:1
        i. this is different then the old 3:1 from CPM and represents running the same data through 6.1 biology to get the new ratios!
8. Minerals to requirements
9. Additives to recommended levels.

Now, how to set those safety factors?

An easy way to set the safety factors is to add at least 0.25 lbs ADG for lactating cows 3rd or greater lactation. For younger cows, add 0.25 lbs to whatever the target ADG is. This equates to about 2 lbs of milk safety factor. Beyond that, setting the formulation safety factor is dependent upon herd management, feed quality, objectives of the farm, and milk and feed pricing.

Millions of cattle are being fed off 6.1 biology around the world and as your experience with the newest biological model grows, so will your comfort!