

NDS Professional and the Automatic Milking System

By RUM&N Staff

Automatic milking system (AMS) is being accepted as a viable alternative to milking parlors throughout several world's regions and its application represents a substantial innovation in the dairy industry.

Among all factors involved, one of the most important in making AMS successful is the ration balancing/nutrition management, because a completely different approach to feeding is required.

For robotic milking system (RMS) herds, a TMR becomes a PMR, or Partially Mixed Ration, containing all the forage and some of the concentrate is offered in the feed bunk. An additional amount of concentrate is now fed through the milking box; this amount varies according to the cow's stage of lactation and milk production.

The proper feeding style is a key step in the RMS herds, where the main goal is to ensure cows are motivated to visit the robot, regardless of barn layout, as one method or theory states the primary motivation for cows to visit the milking box is not because of udder pressure but because of her desire and need to eat. Applying one theory or method to assure the PMR to be effective, it should be balanced for approximately 2 to 6 kg (4 to 12 lbs.) of milk under the herd's bulk-tank average (depending on guided or free flow system design), which will allow for the remaining energy and nutrients to be delivered at the robot.

Greater milking frequency and more uniform milking times resulting from more visits to the milking box increase milk production and animal welfare.

However, it is important to note that every herd is different and ration adjustments can fluctuate based on the herd and the feeding management accomplished, which can include feeding the PMR multiple times per day or pushing up on a regular basis, feeding for low refusals, keeping feeding times and forages consistent, feeding excellent quality forages and cleaning bunks on a regular basis.

NDS Milk Step Feeding tool

Having a clear understanding of the need to redraw rations to properly balance the PMR and the concentrate fed through the robot, RUM&N Development Team developed in 2015 the first version of the **NDS Milk Step Feeding** tool.

After two years of activity, combining our own experiences and the many feedbacks received from users on the subject, we were able to improve the feature and make available a **Version 2** of the tool.

This new version includes several enhancement related to the computing algorithms, more accurate outputs, new outbound information and new functionalities.

The screenshot displays the NDS Milk Step Feeding tool interface. At the top, there are tabs for 'Animal Inputs', 'Comparisons [1]', 'Optimizer', 'P-Size', 'Mixer Wagon', 'Step Feeding', 'Grazing', and 'Info'. The 'Step Feeding' tab is active, showing settings for 'Milk yield' (50,00 Kg/day), 'Production step' (2,00 Kg), and 'Safety threshold' (peNDF (% DM)). Below these settings are buttons for 'Proceed', 'Report', and 'Chart'. The main output is a table with columns for 'Milk range', 'Total DMI', 'Base DMI', 'Robot Grain 2', 'Allowable milk Kg', 'ME', 'HP', 'peNDF (% DM)', 'Ruminal pH', 'Time pH <5.8 (hours)', 'Total', 'Starch (% DM)', 'Supplement', and 'Cost (€/head)'. The table contains 16 rows of data, with some cells highlighted in yellow or red to indicate specific values or deviations.

Milk range	Total DMI	Base DMI	Robot Grain 2	Allowable milk Kg	ME	HP	peNDF (% DM)	Ruminal pH	Time pH <5.8 (hours)	Total	Starch (% DM)	Supplement	Cost (€/head)
29,5 - 30,5	21,92	21,92	0,00	30,0	30,0	26,7	6,19	2,55	21,65	16,83	0,122	5,414	
31,5 - 32,5	23,09	21,75	1,50 (0,50)	32,9	32,9	25,4	6,15	3,22	23,45	17,86	0,122	5,494	
33,5 - 34,5	23,93	22,59	1,50 (0,50)	34,6	34,4	25,4	6,16	3,06	23,39	17,70	0,122	5,701	
35,5 - 36,5	24,76	23,43	1,50 (0,50)	36,3	35,8	25,5	6,15	3,27	23,33	17,54	0,122	5,907	
37,5 - 38,5	25,59	23,43	2,43 (0,81)	38,4	37,8	24,8	6,13	3,74	24,28	18,03	0,198	5,982	
39,5 - 40,5	26,42	23,43	3,35 (1,12)	40,4	39,9	24,1	6,10	4,20	25,17	18,47	0,273	6,058	
41,5 - 42,5	27,24	23,43	4,27 (1,42)	42,4	41,9	23,5	6,08	4,67	26,00	18,87	0,348	6,133	
43,5 - 44,5	28,06	23,43	5,19 (1,73)	44,4	43,9	22,9	6,06	5,14	26,78	19,22	0,422	6,207	
45,5 - 46,5	28,52	22,29	6,98 (2,33)	46,1	45,8	21,6	6,03	5,73	28,44	20,15	0,568	6,072	
47,5 - 48,5	28,78	21,19	8,50 (2,83)	47,2	47,1	20,6	6,01	6,20	29,85	20,96	0,692	5,925	
49,5 - 50,5	28,78	21,19	8,50 (2,83)	47,2	47,1	20,6	6,01	6,20	29,85	20,96	0,692	5,925	

Among the main items we can list:

- calculations for keeping ME allowable milk near the middle of the Milk range at each step
- calculations for minimizing the difference between ME Milk and MP Milk at each step
- a further background condition based on the total starch parameter can determine a correction of the amounts of the involved feeds. The goal of this correction is to limit the total starch, keeping its value under (or around) the critical maximum set into well-being risks management
- addition of the amount of grain assigned per meal, based on the average number of daily milkings, in order to monitor grain delivering rate. The typical eating rate for pelleted concentrates is 0.20 to 0.3 kg/min (0.45 to 0.65 lbs./min). Since cows spend an average of 6 to 8 minutes in the stall per milking, maximum concentrate fed during each milking is 1.2 to 2.4 kg (2.5 to 5.3 lbs.) or 3.6 to 7.2 kg/day (7.9 to 15.9 lbs./day) for a cow visiting 3 times.
- addition of the time of rumen pH < 5.8 for each step as an indicator of rumen well-being
- addition of cost of the supplement as well as the total cost per cow for each step
- developed the Mix Fine-tune feature.

Fine tuning the Step Feeding Mixes

When a mix (created in the recipe or formulated through the Composite add-on module) is included in the step feeding feeds list, a feature is available (after the first run), to check if its composition can be enhanced, in order to achieve a better balance from the step feeding process. In other words, the system tries to make some adjustments to the current mix, using the same ingredients included, with the aim of proposing, provided it is available, an alternative mix composition that should better meet the production goal for each step, both for ME and MP allowable milk.

More in detail, the feature tries to minimize the bias between ME and MP allowable milk expected and the steps set by the user; therefore, the main goals are:

- Keeping ME allowable milk near to the middle of the milk range at each step.
- Minimizing the difference between ME allowable milk and MP allowable milk at each step.

The results of the step feeding process obtained with the new mix are shown, along with the comparison between the old and new compositions; the user can decide if the new mix should replace the current one in the recipe.

The elaboration requires some time to complete, depending on the number of steps in the main process and the number of ingredients of the mix and it consists of two steps: one for creating the alternatives for the mix and the other to simulate the step feeding process and select the best one.

If the system finds a valid alternative for the mix (this won't always be possible), results are presented; otherwise, a message informs that the system has not found any better mix. Notice that if the initial mix is already well suited for the step feeding process, only marginal differences, if any, can be expected; moreover, the cost of the alternative mix in some cases could be higher than the initial one, based on the changes proposed.

The user can accept the new mix, in order to update the composition in the recipe and update the results of the step feeding output screen.

In the upper part of the screen there is a comparison between the initial composition of the mix and the alternative one; the values are percentage on as fed basis, with the difference in the last column.

In the lower part, under the comparison of the fine-tune relative quality and costs of the two versions, the results of the step feeding process can be obtained with the alternative version are displayed.

ID Code	Feeds	Current	Adjusted	Abs. Diff.
C 01039	Corn Grain Ground Fine	50,7000 %	56,1359 %	+5,4359
C 02026	Soybean Meal 44 Solvent	25,3000 %	25,3000 %	
C 08007	Soy Pass	%	%	
C 02028	Soybean Rolled Roasted	8,8000 %	8,8000 %	
C 01103	Soybean Hulls Ground	8,8000 %	3,3641 %	-5,4359
I 05007	Calcium Carbonate	1,8000 %	1,8000 %	
I 05070	Sodium Bicarbonate	1,8000 %	1,8000 %	
I 05038	Magnesium Ox	0,4000 %	0,4000 %	
I 05013	Calcium Phosphate Di (Dical)	0,4000 %	0,4000 %	
I 11044	Dynamate	0,2000 %	0,2000 %	
I 05067	Salt White	1,1000 %	1,1000 %	
I 05081	Vitamin Premix 1	0,6000 %	0,6000 %	

Fine-tune relative quality	1.000	1.163	0.163
Cost €/Tonne	106.08	106.08	0.00

Steps	Milk range	Base DMI Kg	Mix amount Kg as fed	Allowable milk Kg		Cost (€/head)	
	Kg/day			ME	MP	Supplement	Total
1	29,5 - 30,5	21,92	0,00	30,0	30,0		5,414
2	31,5 - 32,5	21,92	0,92 (0,31)	32,0	32,3	0,097	5,511
3	33,5 - 34,5	21,92	1,83 (0,61)	34,0	34,6	0,194	5,609
4	35,5 - 36,5	21,92	2,75 (0,92)	35,9	36,9	0,292	5,706
5	37,5 - 38,5	21,92	3,68 (1,23)	37,9	39,3	0,390	5,804
6	39,5 - 40,5	21,92	4,61 (1,54)	39,9	41,7	0,489	5,903
7	41,5 - 42,5	21,92	5,55 (1,85)	41,9	44,2	0,589	6,003
8	43,5 - 44,5	21,92	6,51 (2,17)	43,9	46,7	0,691	6,105
9	45,5 - 46,5	21,26	7,95 (2,65)	45,7	49,3	0,844	6,093
10	47,5 - 48,5	17,94	12,07 (4,02)	47,7	53,3	1,281	5,710
11	49,5 - 50,5	16,92	13,41 (4,47)	48,5	54,6	1,423	5,602

If two mixes are simultaneously included in the step feeding feed list, it is possible to run the elaboration on both mixes, one by one. Obviously, in this case, the results of the first elaboration can affect those of the second, if the alternative for the first mix is accepted before to run the adjustments for the other mix.

Once accepted, the alternative composition for the selected mix as described above, is still possible to restore the initial mix. This feature restores the mix as it was before running the fine-tuning feature for the first time.

It is important to emphasize that the fine-tuning feature is not a formulation tool, but a function designed to evaluate the quality of the current mix for balancing diet rationing at each step. It looks for possible adjustments in order to better adapt it to the current PMR formulation. In addition, it may indirectly provide useful information to make changes to the current PMR formulation.

Send us your comments on these topics! What do you think about the best and easiest ways for consultants to handle nutritional economics? Dave is at rumendvm@gmail.com; Buzz is at burhans@dairynutritionhealth.com



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 CNCPS 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.

