NASEM Mineral and Vitamin Requirements and Absorption   Rev. 2 of 5/27/2022 EN

The **NASEM 2021** Nutrient Requirements of Dairy Cattle, among the numerous aspects considered, has also updated the Absorbed Requirements or Adequate Intake (AI) for minerals and vitamins, as well as the Absorption Coefficients (AC) for several feed ingredients.
Here is a quick summary of what has been done.

Macrominerals

Calcium: maintenance and lactation requirements have changed very little with a major impact from AC. Overall, dietary requirements changed very little.

Phosphorus: requirements have undergone very small changes, while AC of supplements was not changed.

Magnesium: absorbed requirement was increased (2x for Dry Cow and 1.8x for Lactating Cow). Note that potential benefits of high Mg on hypocalcemia are not included.

Potassium: no changes for pregnancy and lactating cows while the requirement for growth has increased. AC of the feeds has also been increased a little.

Sodium: maintenance requirements have increased in lactating cows and lactation requirements decreased with no changes for growth and pregnancy. AC of the feeds has been slightly increased.

Chloride: maintenance requirements increased in lactating cows and lactation requirements decreased with no changes in growth and pregnancy.

Sulfur: no changes

	Heifer	Dry cow	Lactating cow
Ca	⟷	↑	↑
P	⟷	⟷	⟷
Mg	↑	↑↑	↑↑
K	⟷	⟷	⟷
Na	⟷	⟷	⟷
Cl	⟷	⟷	⟷
S	⟷	⟷	⟷

Microminerals

Two approaches for trace minerals are considered in the new NASEM 2021:

➤ **Requirement**: the daily requirement is defined using a factorial approach. This is set for Copper (Cu) and Zinc (Zn). Copper deserves a special mention because its requirement for lactation has been reduced remarkably. This seems to be important as there were several cases of copper toxicity in some countries over the last few years, so updating these values should be appropriate.

➤ **Adequate intake (AI)**: it is the average daily nutrient intake defined in case only a limited amount of experimental data is available. AI is used when requirements cannot be identified. This approach is set for Cobalt (Co), Iron (Fe), Manganese (Mn), Selenium (Se), Chromium (Cr), and Iodine (I).

Compared to the NRC Dairy 2001, the guidelines for Cu, Mn, and Zn changed extensively. Recommendations for Cr, I, and Co changed, but not widely, whereas the recommendations for Fe and Se remained the same.

	Heifer	Dry cow	Lactating cow
Co	⬆	⬆	⬆
Cu	⬌	⬆⬆	⬌ ⬇
Fe	⬌	⬌	⬌
Mn	⬆⬆	⬆⬆⬆	⬆⬆⬆
Se	⬌	⬌	⬌
Zn	⬌	⬆	⬆

Vitamins

Adequate intake (AI) and no requirements have been defined and AI is intended as supplemental. This approach has been established for vitamins A, D, and E, while no AI was established for water-soluble vitamins.
Vitamin A: Recommended AI increased for high producing cows (>35 kg/d), with no changes for other cattle types.
Vitamin D: assumed D3. Recommended AI increased for lactating cows, unchanged for heifers and dry cows.
Vitamin E: AI increased for pre-fresh cows (2-3 weeks pre-calving), unchanged for heifers, dry and lactating cows.

	Heifer	Dry cow	Lactating cow
Vit A	⬌	⬌	⬌ ⬆
Vit D	⬌	⬌	⬆
Vit E	⬌	⬌ ⬆	⬌

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NDS Update for Mineral and Vitamin

After a thorough check, the development group at RUM&N incorporated the mineral and vitamin updates into **NDS Professional**. There are several updates to this section and we updated the requirement equations for most minerals and vitamins. Also, the Absorption Coefficients (AC), formerly defined as Bioavailability, have been changed. This will have some significant impacts on diet formulation and evaluation.

Requirements

All the new equations for the definition of requirements or Adequate Intake for all minerals and vitamins have been implemented in parallel to those currently used by NDS deriving from the NRC Dairy 2001.
This means that it is now optionally possible to define the set of equations to invoke.

	Diet				Absorbed				
	Total intake	Concentration	Added	Organic	Supplied	Requirements	Balance	% Req.	AC
NRC 2001									
NASEM 2021									
Ca	159,61 g	0,61 % DM			83,0 g	76,3 g	+6,7 g	109%	0,520
P	96,73 g	0,37 % DM			67,4 g	67,4 g	g	100%	0,696

A button has been added in the Minerals tab to allow switching between the two sets of equations.
When the NASEM Dairy 2021 calculations are active the button will be populated with the icon of the NASEM-Dairy-8 software.

Requirements calculated according to NRC Dairy 2001

	Ration	Water	Total intake	Concentration	Added	Organic	Supplied	Requirements	Balance	% Req.	AC
			Diet						Absorbed		
Ca	159,61 g		159,61 g	0,61 % DM			83,0 g	76,3 g	+6,7 g	109%	0,520
P	96,73 g		96,73 g	0,37 % DM			67,4 g	67,4 g	g	100%	0,696
Mg	54,02 g		54,02 g	0,21 % DM			10,4 g	8,7 g	+1,8 g	120%	0,193

Requirements calculated according to NASEM Dairy 2021
The update of the Absorption Coefficients of feeds based on the same source it is recommended

	Ration	Water	Total intake	Concentration	Added	Organic	Supplied	Requirements	Balance	% Req.	AC
			Diet						Absorbed		
Ca	156,59 g		156,59 g	0,58 % DM			73,0 g	67,5 g	+5,5 g	108%	0,466
P	104,71 g		104,71 g	0,39 % DM			75,1 g	64,2 g	+10,9 g	117%	0,717

Absorption Coefficients

The implementation of the new mineral Absorption Coefficients (AC) proposed by NASEM 2021 for the feeds shows aspects of greater complexity as regards their implementation.
What we have done is:

➢ Updated the AC for all feeds included in the RUM&N Feed Library
➢ Left unchanged the AC for all feeds in the CNCPS Feed Library. They will be updated as soon as the appropriately updated Feed Library for these values is provided to us by the Cornell group.
➢ Left unchanged the AC for all user feeds

Concerning this last point, some activities can be undertaken by the user:

1. For all feeds cloned by the RUM&N Feed Library, the update of the AC for each feed can be obtained through the Minerals/Bioavailability tab, by clicking on the small button circled in red in the figure below. The old AC will be replaced by the new ones. Please remember to save the feed again at the end of the process.

2. A similar procedure can be launched to obtain the same result for a list of feeds. Through the Utility tab in the Feeds section, it is possible to launch the Recalculate analysis command with both the Make cloning and Update Absorption Coefficients checkboxes checked.
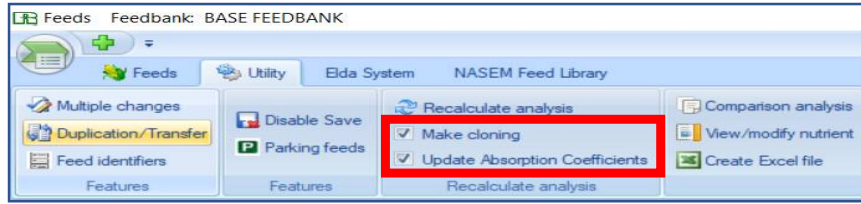
The procedure, launched first for Forages and then for Concentrates in two separate sessions, will update the AC values for all the feeds previously cloned by the RUM&N Feed Library.

Also for minerals created by the user, it will be necessary to update the AC values. This can be done by following the instructions in #1. Please note that for minerals not previously cloned by RUM&N Feed Library, you will need to do this first.

This procedure may take several minutes, based on the number of feeds to be processed. It is recommended to make a **backup copy** of the database before proceeding with the Recalculate analysis feature. Furthermore, for groups of users connected to a single **SQL database**, the procedure can be launched by only one of them (the administrator of the group, for instance).

It is worth emphasizing once again that the procedure described in #2 will have no impact on the feeds previously cloned by the CNCPS Feed Library. Instead, it will take effect (AC update) when the CNCPS Feed Library will also be updated. We will take care to disseminate it as soon as we receive it. Therefore, for the users who have cloned their feeds mainly from the CNCPS Feed Library, it is suggested, for the moment, to use the procedure described in the next item #3.

3. For those who have installed the **NASEM-Dairy-8** software on their device, the update of the AC for each user feed can be obtained by taking the data directly from the **NASEM Feed Library**.

   If this condition is met, in the Minerals/Bioavailability tab a new button will be shown:

This button will open a window with a list of feeds taken directly from the NASEM Feed Library, already pre-selected based on the partition (Forages, Concentrates, Minerals/Vitamins).

Then, filtering by name, it is possible to identify the NASEM food from which to pre-collect the AC which will replace those currently specified in the user feed. By clicking on the selected feed, the feature will replace, after confirmation, the available AC values.

The feed will have to be saved again to implement the changes.

In order to facilitate the identification of user feeds that are not up to date for the Absorption Coefficients proposed by NASEM 2021 when the NASEM Dairy 2021 requirements are set, these feeds are marked with a magnifying glass with a small red triangle

This indicator helps to easily open the feed and update it for mineral AC (with one of the available options, # 1 or # 3) so that the recipe is also updated accordingly. When returning to the recipe screen, after saving the updated feeds, the conventional magnifying glass will appear again to indicate that the feed is now also updated for its AC.

In summary, the choice of the updated set of equations for the requirements by the user will be logical and reasonable only if the user will update the old AC with the new ones using one of the procedures described above.