Knowledge grows

Unravelling the language of phosphorus utilisation

Phosphorus (P), like other nutrients, is not fully absorbed and utilized by the animal in any feedstuff, including inorganic feed phosphates. Accurate knowledge of the P fraction which is utilized by the animal, or P value of an ingredient, is needed to formulate optimal diets for livestock, maximise livestock production efficiency and minimize P voiding. The P value can be calculated as the total P content times its "availability". However the high number of research techniques and concepts such as bioavailability, digestibility, apparent digestibility, standard digestibility associated to phosphorus can generate confusion. The aim of this brochure is to create clarity and avoid comparing apples with oranges when we talk about phosphorus in monogastric nutrition.

Relative bioavailability:

This method assigns a biological value of 100% to a reference phosphate. The relative biological value of other test phosphates are determined by comparing the results obtained for a response criteria among all the P sources tested. Its value is expressed in relation to the biological value of a standard source used. Bone ash, density and breaking strength or body weight gain, have been classically used as response criteria. As a consequence of the methodology, results vary between different researches because of differences in protocols, reference phosphate used and its origin. It is a qualitative measurement and has no value for diet formulation.

No-phytic phosphorus

Phytate phosphorus has long been assumed to be unavailable to monogastrics. Thus, the non-phytate P (i.e. inorganic feed phosphates) has been assumed to be fully available, and therefore calculated as follows: *No-Phytic P=Total P-Phytate P*. However, it has been shown that, due to the (1) intrinsic (dietary), (2) endogenous mucosal, and (3) microbiota-associated phytases, monogastrics can partially degrade phytate.

Digestible phosphorus

It is the proportion of dietary P that has disappeared from the small intestine. It is measured by recovering the digesta at the terminal ileum.

Apparent total tract digestible P (ATTD P): does no differentiate between dietary undigested and digested but unabsorbed P and endogenous P at the terminal ileum. Therefore it underestimates the true amount of digestible P.

$$\text{ATTD P} = \frac{\text{Total P - Faecal P}}{\text{Total P}}$$

Standard total tract digestible P (STTD P): Corrects for basal endogenous P losses

$$\text{STTD P} = \frac{\text{Total P - (Faecal P - P basal endogenous losses)}}{\text{Total P}}$$

Apparent total tract digestible P (ATTD P): since urine and faeces cannot be separated in poultry, ATTD P does no differentiate between absorbed and no-utilized P, dietary undigested and unabsorbed P and endogenous P at the terminal ileum. Therefore it underestimates the true amount of digestible P.

$$\text{ATTD P} = \frac{\text{Total P -(Faecal P+P urine)}}{\text{Total P}}$$

Precaecal P digestibility (pcdP) avoids the underestimation of true digestible P by ATTD P in the case that absorbed, but undigested P, is excreted via urine. Correction for endogenous P losses is not necessary.

$$\text{pcdP} = \frac{\text{Total P -P content in the terminal ileum}}{\text{Total P}}$$

Literature

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