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Limestone calcium content and digestibility for pigs

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This issue explains why limestone sources differ in total and digestible calcium and how accounting for these differences can help prevent calcium excess or deficiency in pig diets.

Limestone is commonly treated as a simple, inexpensive source of calcium. Research led by Professor Hans H. Stein at the University of Illinois shows why it deserves closer attention. Across studies involving 38 limestone sources, his team has examined two separate sources of formulation error: differences in total calcium concentration and differences in the digestibility of that calcium. Consequently, two limestones added at the same inclusion rate can supply meaningfully different amounts of digestible calcium to pigs. The ingredient name alone does not tell the nutritionist how much calcium the source will contribute.

This matters whenever a feed mill changes its limestone supply without updating the formulation matrix. A diet can remain correct on the formulation screen while its actual calcium supply changes. The immediate practical question is whether the calcium concentration assigned to the limestone represents the material being delivered. The next is whether the digestibility value is appropriate, including the effect of phytase. Getting one of these inputs right does not compensate for getting the other wrong. And because calcium interacts with phosphorus, the consequences extend beyond calcium supply itself.

Total concentration variability

Chemically pure calcium carbonate contains about 40% calcium, but feed-grade limestone also contains other minerals. Across 20 sources from the United States, Europe, Asia, and South Africa, analyzed calcium ranged from 32% to 41%; 14 Latin American sources ranged from 33% to 40%. Feed analyses also carry recognized analytical variation, so one result must be interpreted within the method's uncertainty. A fixed book value cannot ensure a consistent supply when the mine, product, or blend changes. NRC 2012 lists 38.5%, but analysis of the purchased material is the better input.

Digestibility creates a second difference

Total calcium analysis measures how much is present, not how much is absorbed. Standardized total tract digestibility, or STTD, corrects apparent digestibility for basal endogenous calcium losses. Across the 20 international sources, STTD calcium ranged from about 70% to 84%, averaged across diets with and without phytase. These values depend on feeding conditions: 1,000 FYT/kg increased average STTD calcium from about 75% to 84% in that experiment. Formulation must therefore account for both limestone source and phytase use, crediting the calcium contribution of phytase once.

The two differences multiply
Digestible calcium equals total calcium multiplied by STTD. Among the 20 international sources, it ranged from about 26% to 34%, averaged across phytase treatments. At 1% inclusion, that supplies about 0.26% to 0.34% STTD calcium in feed—a difference of 0.8 g/kg. Latin American sources supplied about 23% to 30%. In that study, however, STTD calcium did not differ statistically; analyzed calcium drove the significant difference in digestible supply. Both inputs matter, but not equally in every dataset.

Excess calcium is not harmless
Limestone's low price can make extra allowance seem inexpensive. It is also a common carrier in supplements, adding calcium that may be overlooked. Yet excess calcium can reduce phosphorus digestibility and disturb the intended digestible calcium-to-phosphorus relationship. In 100- to 130-kg pigs, increasing STTD calcium reduced feed intake; its effect on gain depended on phosphorus supply, with growth depressed when phosphorus was at or below requirement. Count all calcium sources rather than adding limestone as cheap insurance.

Too little calcium also has a cost
An average limestone value can create the opposite error when the source supplies less digestible calcium than expected. Calcium deficiency compromises skeletal mineralization and, when sufficiently severe, can impair growth and feed efficiency. Performance alone is not an adequate warning: the calcium supply needed to maximize bone ash may exceed that needed to maximize daily gain. This does not mean every pig below maximum bone ash has a skeletal disorder. For replacement gilts, my practical judgment is that satisfactory growth alone provides insufficient reassurance about mineral nutrition, given their intended breeding life.

Specify the source, not the ingredient
Purchasing specifications should identify the limestone product and origin because suppliers may obtain material from several mines. Specify calcium concentration, analyze when the source changes, and check periodically. Use reliable source-specific STTD values where available; otherwise, select an appropriate reference and account consistently for phytase. Count calcium from phosphates, premixes, carriers, and other ingredients. In my judgment, routine total-calcium verification is the first commercial priority, even where source-specific digestibility data are unavailable. Detailed matrices still depend on knowing what is delivered.

In Brief, limestone sources differ in calcium concentration and digestibility, and phytase changes digestible supply. The practical priorities are to verify total calcium, use suitable digestibility values, credit phytase consistently, and count calcium from every ingredient. Excess calcium can impair phosphorus use and growth; insufficient calcium can limit bone mineralization before performance signals a problem. Limestone deserves the same attention to specifications and matrix accuracy as other nutritionally important ingredients.

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