Given the current growing number of commercial phytase products, quite often with claims of meteoric efficacy in releasing phytate phosphorus, nutritionists are faced with the difficult task of separating marketing from science. The evaluation of enzymes, however, is far from being straightforward, as the interpretation of efficacy is influenced by a number of factors, one of which is optimal pH.

All commercial phytases, either of fungal or bacterial origin, belong to the class of histidine acidic phosphatases meaning that they require an acidic environment for maximal efficacy to release phytate phosphorus. This pH ranges mostly from 3 to 6.

At pH below 2.5, phytases of different origins can exhibit substantial differences in their efficacy. Indeed, in a study comparing the relative pH activity curves of different phytases (Figure 1), one of the two phytases was about one third less effective than the other two products at low pH. Such pH curves are quite often used to promote many commercial products, but this can lead to quite erroneous conclusions.

Super-acidic conditions as described above may not exist in the gastrointestinal system of poultry when feed is present because components such as limestone act to buffer low pH. Thus while secretions can be quite acidic, the presence of feed can quickly increase pH. The majority of phytate phosphorus release is initiated in the crop, where feed residence time is significantly longer than in the proventriculus and gizzard.

Furthermore, pH curves are derived with laboratory tests that use sodium phytate as a substrate. Sodium phytate is a convenient and highly soluble phytate compound in conducting such trials, yet differs significantly from naturally occurring phytate found in feed ingredients. Recent research demonstrated that with typical maize-soybean meal diets, optimal pH for some phytases is shifted toward the acidic end (by about a whole pH unit). This implies that caution is warranted in the interpretation of data that were generated using simple enzyme tests with different conditions than can be found in the animal.

In brief: pH curves are useful in the development process of phytase products. Most commercial phytases are engineered to work under conditions typically found in the gastrointestinal tract of poultry. It is better to rely on other more meaningful indexes, such as efficacy of phosphorus release, thermal stability, and of course, return-on-investment or feed cost savings, when differentiating among available phytase products!

Phytase pH Curve Myths!

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<table>
<thead>
<tr>
<th>Intestinal pH of chickens</th>
<th>Gao et al., 2008</th>
<th>Murali et al., 2001</th>
<th>Rynsburger &amp; Classen, 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop</td>
<td>4.9</td>
<td>5.9</td>
<td>5.0 to 6.0</td>
</tr>
<tr>
<td>Proventriculus</td>
<td>5.4 to 5.3</td>
<td>5.2 to 3.4</td>
<td></td>
</tr>
<tr>
<td>Gizzard</td>
<td>4.9 to 4.0</td>
<td>3.5 to 3.3</td>
<td></td>
</tr>
<tr>
<td>Duodenum</td>
<td>6.1 to 6.2</td>
<td>6.6 to 6.4</td>
<td></td>
</tr>
<tr>
<td>Jejunum</td>
<td>6.6 to 6.7</td>
<td>6.8 to 6.5</td>
<td></td>
</tr>
<tr>
<td>Intestine</td>
<td>6.4</td>
<td></td>
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</tr>
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The pH in the crop is acidic but ranges from 4.5 to 6.0, and never as low as 2.5 (Figure 2). Also in the proventriculus and gizzard, the average pH values are above pH 3. Thus the performance of most commercial phytases cannot be differentiated based on their activity at super-low pH levels created in laboratory assays.

Furthermore, pH curves are derived with laboratory tests that use sodium phytate as a substrate. Sodium phytate is a convenient and highly soluble phytate compound in conducting such trials, yet differs significantly from naturally occurring phytate found in feed ingredients. Recent research demonstrated that with typical maize-soybean meal diets, optimal pH for some phytases is shifted toward the acidic end (by about a whole pH unit). This implies that caution is warranted in the interpretation of data that were generated using simple enzyme tests with different conditions than can be found in the animal.

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