Sodium Bisulfate Pet™: The Leader in Dry Acidification

Jones-Hamilton Co. leads the way in dry acidification research and development for the pet food industry. We strive to develop partnerships with our customers to encourage continuous research, cost reduction and manufacturing flexibility.

Acid Strength Comparison

Acid strength is denoted by pKa value (Figure 1). The lower the pKa value the stronger the acid. The pKa value indicates the ease at which the hydrogen ion dissociates. Since pH is a measurement of hydrogen ion concentration, acids with a low pKa value will do a better job at lowering pH.

For pH applications below 3.6, less Sodium Bisulfate Pet™ is required to lower pH than most commonly used acids, including phosphoric acid (Figure 2). This provides for cost savings in a food, digest, treat, slurry or any low pH application.

Figure 1.

<table>
<thead>
<tr>
<th>Acid</th>
<th>pKa value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Bisulfate</td>
<td>1.99</td>
</tr>
<tr>
<td>SAPP</td>
<td>2.10</td>
</tr>
<tr>
<td>Phosphoric Acid</td>
<td>2.16</td>
</tr>
<tr>
<td>Citric Acid</td>
<td>3.14</td>
</tr>
<tr>
<td>Acetic Acid</td>
<td>4.75</td>
</tr>
<tr>
<td>Propionic Acid</td>
<td>4.87</td>
</tr>
</tbody>
</table>

Figure 2. Comparison of Sodium Bisulfate and Phosphoric Acid for pH Reduction of 1 Liter of a 10% Fish Slurry

<table>
<thead>
<tr>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grams of SBS Pet</td>
</tr>
<tr>
<td>2.85</td>
</tr>
<tr>
<td>3.03</td>
</tr>
<tr>
<td>3.19</td>
</tr>
<tr>
<td>3.40</td>
</tr>
<tr>
<td>3.60</td>
</tr>
<tr>
<td>3.80</td>
</tr>
<tr>
<td>4.03</td>
</tr>
<tr>
<td>4.26</td>
</tr>
<tr>
<td>4.52</td>
</tr>
<tr>
<td>4.83</td>
</tr>
</tbody>
</table>

Sodium Bisulfate Pet™ is a dry granular acid that easily dissolves in water. Its chemical formula is NaHSO₃. In a water solution, it dissociates into sodium ions, hydrogen ions and sulfate ions. NaHSO₃ → Na⁺ + H⁺ + SO₃⁻². In 1997 sodium bisulfate was approved for use in animal feed. It is classified as a general purpose feed additive under the Association of American Feed Control Officials’ (AAFCO) Feed Ingredient Definition. In 1998 the Food and Drug Administration (FDA) categorized sodium bisulfate as GRAS (Generally Recognized As Safe) for use in human foods.

Feline Urine Acidification With Sodium Bisulfate Pet™

Formation of struvite crystals in the lower urinary tract is a common cause of lower urinary tract diseases. In some cases, complete obstruction occurs. Urine acidification can dissolve existing crystals and prevent the formation of new crystals. A urine pH of 6.0 to 6.5 is an acceptable range to prevent the formation of crystals.

Studies prove that sodium bisulfate significantly lowers feline urine pH. The mode by which it affects urine pH is twofold.

The cation-anion balance of the diet affects urine pH of healthy cats. The more negative the balance, the greater the acidifying potential of the diet.

Sodium bisulfate has a cation-anion balance of -1 which causes the urine to be acidified. Compounds that result in the absorption of hydrogen ions produce acidic urine. The addition of sodium bisulfate to the diet results in the absorption of hydrogen ions therefore lowering urine pH.

Urine Acidification Research Results

Summit Ridge Farms - 1998

In 1998, a urine pH study was conducted at Summit Ridge Farms, Susquehanna, PA. Ten adult cats were placed on a diet that contained 0.9% sodium bisulfate for seven days. On the seventh day urine samples were obtained by cystocentesis. The test was performed in triplicate with the following results:

<table>
<thead>
<tr>
<th>Mean Urine pH</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.24</td>
<td>6.45</td>
<td>6.37</td>
<td></td>
</tr>
</tbody>
</table>

The urine pH of the diets that contained sodium bisulfate were significantly lower than the control diet.

University of Illinois - 2002

A 2002 study at the University of Illinois evaluated sodium bisulfate as a urinary tract acidifier for cats. Dr. George Fahey, Chris Grieshop and Julie Spears designed and conducted a study comparing the effectiveness and duration of sodium bisulfate and phosphoric acid for lowering urinary pH.

Eighteen cats were utilized in the study that covered a four week time period. A basal urine pH was determined for a commercially available diet. After meal consumption, urine pH rose as high as 6.89 and remained above the recommended level of 6.5 for 8 hours.
Palatability

When pH rises above 6.5, struvite uroliths can form.

Three test diets containing sodium bisulfate and three containing phosphoric acid were made where the only difference between the diets was the acidifier added and the concentration. Cats were acclimated to the test diets for 6 days. On day 7 urine samples were collected at 0, 4, and 8 hours post-feeding via cystocentesis.

For all of the test diets, urine pH remained in the range that guarantees a low-strugitive environment. They concluded that sodium bisulfate and phosphoric acid generally behave in similar fashion when incorporated into a dietary matrix formulated for cats.

Research shows that cats tend to prefer food with an acid pH over neutral or alkaline foods. This would account for the use of acids in animal digest and palatability enhancers.

To determine the effects of sodium bisulfate on palatability in cat food, a major petfood manufacturer in the United States performed a standard two-bowl palatability test utilizing twenty cats for two days at an independent animal testing facility. A typical chicken-and-rice-based extruded cat food containing either 0.9% sodium bisulfate or 0.8% phosphoric acid was tested.

First choice preference and total consumption were monitored. Data demonstrated a numerical trend toward the diet containing sodium bisulfate in both observations. The sodium bisulfate diet was chosen 2.25:1 over the phosphoric acid diet and had a 1.42:1 consumption ratio (Figures 3 and 4).

Palatability tests on animals generate information on preference and amount consumed, however, they do not tell specifics about the taste. Acids are added to human food to impart a sour taste. In fact, the only substances known to produce a sour taste are acids. The following study was conducted on humans, however, it may help us to understand the flavor preferences of animals.

Taste Test

A flavor evaluation was conducted by Sensory Spectrum, Inc. Chatham, NJ, to compare the flavor profiles of sodium bisulfate with citric, malic, and phosphoric acids (Figure 5). The acid solutions were evaluated at low, medium, and high concentrations and the sodium bisulfate solution was found to have a very clean, sour flavor that was more intense than other acids.

These results indicate that sodium bisulfate has a higher sour intensity than phosphoric, citric and malic acids. (Figure 6). No bitter taste was associated with sodium bisulfate or phosphoric acid.

Sodium Bisulfate Pet can improve palatability with a clean, tart flavor. A higher sour intensity means lower concentrations in your pet food formulas.
Benefits

- Price Competitive
- Effective Urine Acidification
- Improved Palatability
- pH Reduction/Stability
- Nutritional Justification
- No Effect on Ca/P Ratio
- Can Use Existing Ingredient Equipment
- Safe Material Handling
- Low Addition Rate

Nutritional Issues

Sodium

Sodium is an essential part of a cat’s diet. Recent studies indicate that cats have a higher sodium requirement for maintenance than the value of 0.5 g/kg diet proposed by the National Research Council (1986). A minimal sodium requirement of 0.8 g/kg diet has been proposed for maintenance of adult cats. Sodium deficient cats can exhibit anorexia, weight loss, hyponatriuria and a negative sodium balance. The addition of sodium bisulfate to the diet may contribute to meeting the higher sodium requirement.

Calcium / Phosphorus Ratio

Sodium bisulfate acidifies the diet and improves palatability without affecting the calcium/phosphorus ratio. The ideal ratio of calcium to phosphorus in the diet is 1:1. If the ratio is too high it can impair phosphorus absorption. If it is too low it can lead to many nutritional problems from calcium deficiency—including bone loss.

Sulfate

- Inorganic sulfate is an essential electrolyte required by all organisms for life.
- Involved in detoxification via sulfation.
- Required for cell matrix synthesis and maintenance of cell membranes.
- Involved in the formation of sulfated glycosaminoglycans, major components of cartilage.
- Involved in the formation of cerebroside sulfate, a constituent in the myelin membranes of the brain.
- Sulfate conjugation serves a role in the biosynthetic pathway for the production of steroids, neurotransmitters and bile agents.

Sodium Bisulfate Pet™ assists with stabilizing your pet food formulation because of its ability to quickly lower pH with relatively low addition rates.

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References


Certifications

- FDA approved for use in animal feed in 1997
- AAFCO Feed Ingredient Definition: General Purpose Food Additive Table #87.5
- CVM (Center for Veterinary Medicine):
   Accepted for use in pet food as an acidulant at levels consistent with good manufacturing practices, March 1999.
   Acceptable ingredient in cat foods seeking to make urinary health tract claims. Justified on a Nutritional Basis.
- Manufactured under FDA GMP’s
- Formal HACCP program in place.
- Meets Food Chemicals Codex Specifications
- NSF approved for use in potable water
- ISO Certified
- U.S. Patent 5,773,063

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