Ionophores: A Technology to Improve Cattle Efficiency

This article explains how the use of ionophores—antibiotics that shift ruminal fermentation patterns—can improve cattle production efficiency.

In light of popular press discussions and consumer concerns surrounding antibiotic use in livestock, and the launching of the Veterinary Feed Directive (VFD) in January 2017, the discussion of one particular class of antibiotics used by cattle producers is relevant. Ionophores are a class of antibiotics that are used in cattle production to shift ruminal fermentation patterns. They are not bactericidal (they do not kill the bacteria); they simply inhibit their functionality and ability to reproduce. Therefore, ionophores are not just antibiotics—they are antibiotics that target specific bacteria. Because of their specificity, ionophores are not used in medically relevant human applications (i.e., in hospitals to treat human disease). Therefore, ionophores are not currently regulated under the VFD and may be fed to cattle to improve feed efficiency. But why are they fed, and how do they improve feed efficiency?

In the rumen, the first chamber in cattle stomachs, microorganisms convert feed to volatile fatty acids (VFAs). It is these VFAs that are absorbed from the rumen and supply the majority of the energy cattle need, not the feeds themselves as in nonruminant animals. Thus, a healthy, functioning rumen is critical to the health and well-being of cattle.

There are three major VFAs produced in the rumen: acetate, propionate, and butyrate (Table 1). Acetate is produced in the greatest quantity, followed by propionate, and finally butyrate.

There are other lesser VFAs, but these three provide the majority of energy to cattle. As previously mentioned, VFAs are produced during the degradation of feedstuffs. Thus, different feedstuffs can shift VFA production. For example, in cattle fed predominantly forage, there are as many as four to six acetate molecules produced for every propionate molecule produced. In cattle that are fed predominantly grain diets, this proportion shifts such that there are two acetate molecules produced for every propionate molecule produced. We call this the acetate-to-propionate ratio and use it as an indicator of ruminal efficiency.

<table>
<thead>
<tr>
<th>Volatile fatty acids</th>
<th>Forage-based Diets</th>
<th>Grain-based Diets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetate</td>
<td>65-70%</td>
<td>50-60%</td>
</tr>
<tr>
<td>Propionate</td>
<td>15-25%</td>
<td>35-45%</td>
</tr>
<tr>
<td>Butyrate</td>
<td>5-10%</td>
<td>5-10%</td>
</tr>
</tbody>
</table>

Microorganisms that break down feeds do so with different levels of efficiency. Although they are the largest proportion of the ruminal VFAs, acetogenic bacteria that make acetate from glucose are considered inefficient because every conversion of glucose to acetate represents a net two carbon loss, usually as methane (CH4). Carbon is energy, and energy loss equals inefficiency. However, when microorganisms convert glucose to propionate, there is no net carbon loss. Thus, propionate production represents a more energetically efficient pathway in the rumen. What does all this have to do with ionophores? The aforementioned specific target of ionophores is the bacteria in the rumen that produce acetate. Ionophores inhibit acetogenic bacteria. This inhibition of acetogenic bacteria gives a competitive advantage to the propionate-producing bacteria, which are more energetically efficient.

Ionophores are generally considered a good investment for cattle regardless of diet fed. However, they are used most extensively in the diets of feedlot cattle. In fact, it is estimated that 90 percent of the cattle on feed in the United States are fed ionophores. One of the reasons for the tremendous adoption of this particular technology is the consistent return on investment. The net return on investment when ionophores are fed to cattle equates to approximately $20 per head (Elanco
Ionophores: A Technology to Improve Cattle Efficiency (Animal Health, 2015). Return on investment in ionophores is due to the 5 to 10 percent increase in efficiency noted in cattle fed ionophores when compared to those that are not fed ionophores. In conclusion, ionophores are a non-medically relevant class of antibiotics; thus, they are not regulated by the VFD and are considered safe and efficacious for use in cattle feed. Ionophores are fed to cattle consuming forage or grain to shift the acetate-to-propionate ratio to make relatively more propionate. These shifts in ruminal fermentation increase cattle feed efficiency, which not only improves profitability but also reduces methane production from cattle enterprises.

Sources

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