LACTROL® Antimicrobial Resistance Facts and Fiction

Should Ethanol Plants be Concerned about Antibiotic Resistance?

One of the common misconceptions throughout the industry is the potential occurrence of antibiotic resistance in a fuel ethanol plant. To understand the probability of such an occurrence with antibiotics, in particular LACTROL, it's important to know a bacteria's minimum inhibitory concentration (MIC) versus resistance to an antimicrobial.

MIC and Resistance

MIC is the ability of bacteria to grow up to a threshold antimicrobial concentration. Dosages above the threshold do not permit bacterial growth.

Resistance is the ability of bacteria to grow at any antimicrobial concentration.

Antimicrobial Capacity - Dosage Does Matter

To summarize, resistance explicitly implies that no level of antimicrobial will kill the targeted bacteria. With decades of experience in the field, we have yet to see resistance. Commonly misunderstood, this concept can often lead to the conclusion that a resistant bacteria exists when in fact the particular antimicrobial dosage is not sufficient to overcome the MIC of the bacteria. The necessary dosage is not only dependant on the MIC of bacteria, but also on the species of bacteria, and on bacterial loading (number of viable bacteria). If the concentration of bacteria in mash exceeds the amount of antibiotic being applied, it could easily appear that a resistant species of bacteria has infected the plant. In reality, an under-dose of the antimicrobial has created an environment where bacteria tolerant to this specific under-dose will grow and out-compete bacteria susceptible to the dose.

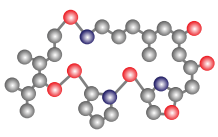
How does Penicillin Compare?

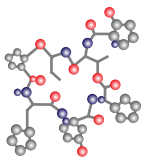
Penicillin-based antimicrobials are used occasionally for bacterial control in the ethanol industry. Penicillin interrupts the creation of the bacterial cell wall only during the exponential (growth) phase of bacterial life and does not affect bacteria that are already established. Furthermore, Penicillin is also unstable at fermentation temperatures and pH levels, making it susceptible to the rise of resistant bacteria. These well-documented inherent deficiencies in Penicillin have led to the widespread use of Virginiamycin (the active ingredient in LACTROL) for bacterial control.

Factor M and Factor S

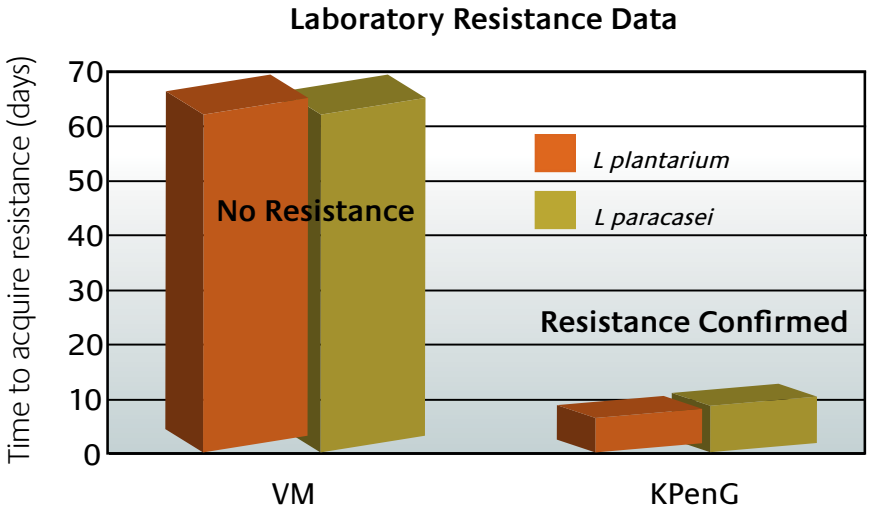
LACTROL is unique in that its active ingredient, Virginiamycin, is composed of two distinct molecules: factor M and factor S. Each of these factors (alone or in synergy) disrupts protein synthesis by attaching to two different physical locations on the bacterial ribosome (the "factory" of the bacteria). Because it inhibits protein synthesis, Virginiamycin is very effective at killing bacteria in all phases of bacterial life. This mode of action combined with its two distinct factors (M and S) results in a product, LACTROL, where no practical concern exists for the development of bacterial resistance.

In order for bacteria to develop resistance to LACTROL (Virginiamycin), it would need to undergo an accelerated physical change to its "protein factory" for it to become resistant to both the M and S factors and continue to live and reproduce. Phibro has demonstrated this fact by running a laboratory test on bacterial species most common to ethanol plants, and found that this probability is decreased even further during real operating conditions and practices.

Factor M 

Factor S 

GRAS GENERALLY RECOGNIZED AS SAFE



The products evaluated and summarized in the graph above were: Virginiamycin (VM) and Penicillin. After 70 consecutive days of continuously "bathing" the bacteria to LACTROL, the experiment was discontinued as the two *Lactobacillus* species (commonly found in ethanol plants) had not acquired resistance to virginiamycin. The composition and molecular mode of action of LACTROL had prevented bacterial resistance.

More than 500 Different Bacteria Examined

In addition to the long-term studies above, Phibro has isolated and cataloged over 500 different bacteria from operating fuel ethanol plants in North America and has received the most common isolates. None of the bacteria isolates received have shown resistance (or could be deliberately induced to show resistance) to LACTROL. In addition, ethanol plants that have used LACTROL for more than 15 years have yet to show any contamination involving bacteria resistant to LACTROL.

Proven Most Effective Antimicrobial in Use Today

LACTROL, with the active ingredient Virginiamycin, has been proven to be the most effective antimicrobial in use today. It performs well in fuel ethanol plants because of its superior stability at fermentation temperature and pH, it acts on the most prevalent bacteria present and its mode of action kills bacteria in all phases of growth. The presence of the dual acting factors M and S result in a synergistic product where the occurrence of resistance has diminished beyond practical industrial concern. We'll stack our decades of fermentation experience and efficacy against anyone's claims regarding resistance to LACTROL at an ethanol plant.

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