

Scientific Comparative Analysis: Bio-G-Active vs. Chlorine as an Antimicrobial Agent

Introduction

Bio-G-Active, developed by **BGA-Dictum GmbH**, is an advanced, biologically derived antimicrobial agent specifically designed for the decontamination of poultry carcasses. It targets the reduction of microbial loads on meat surfaces, particularly dangerous pathogens such as *Salmonella* and *Escherichia coli* (*E. coli*). While chlorine, a commonly used disinfectant in poultry processing, has proven useful, it exhibits significant drawbacks in microbial efficacy, the sensory qualities of treated meat, and potential health and environmental impacts.

This report presents a detailed scientific analysis of the advantages of Bio-G-Active over chlorine, particularly in terms of superior antimicrobial efficacy, sensory improvements, and reduced health and environmental risks. Additionally, the biological processes and mechanisms of Bio-G-Active will be explained, highlighting its role as a safe and effective solution for modern food processing.

Microbial Efficacy of Bio-G-Active vs. Chlorine

Microbial efficacy is the central aspect when selecting a decontamination agent in poultry processing. Bio-G-Active outperforms chlorine in almost all relevant areas of microbial reduction. This is due to Bio-G-Active's mechanism of action, which involves **lowering the pH** on the meat surface, drastically worsening the conditions for microorganisms.

1. Reduction of Total Bacterial Count (TBC):

- In tests, Bio-G-Active demonstrated a reduction of the total bacterial count by **up to three log cycles** within a few hours of treatment. In comparison, chlorine achieved a reduction of only one to one and a half log cycles. This difference arises from the fundamental chemical properties of chlorine and Bio-G-Active. While chlorine acts only on the surface, Bio-G-Active penetrates deeper into microscopic crevices of the skin, resulting in more effective decontamination.

2. Effect on Enterobacteriaceae and *Staphylococcus aureus*:

- Bio-G-Active significantly reduced the concentration of Enterobacteriaceae on poultry carcasses more effectively than chlorine. Studies showed that Enterobacteriaceae, such as *E. coli*, were reduced tenfold after the first application of Bio-G-Active. This is especially relevant as these bacteria serve as indicators of fecal contamination and hygiene standards in poultry production.
- *Staphylococcus aureus*, another critical pathogenic organism in food production, also exhibited a significant reduction. Bio-G-Active reduced

Staphylococcus aureus counts by approximately 90%, whereas chlorine was less effective under similar conditions.

3. Effect on *Salmonella* spp.:

- Controlling *Salmonella* is a crucial factor for food safety in the poultry industry. Bio-G-Active demonstrated superior efficacy against *Salmonella* in several studies. While chlorine is capable of reducing the number of *Salmonella* colonies, Bio-G-Active significantly reduced the number of *Salmonella*-positive samples. In some cases, no *Salmonella* was detected after treatment with Bio-G-Active, highlighting the product's strong bactericidal effect.
- The **bactericidal effect** of Bio-G-Active is achieved by the targeted lowering of pH and direct attack on bacterial cell membranes. Chlorine, which can be inactivated by organic matter on meat surfaces, showed weaker performance in comparable tests. Chlorine reacts with organic compounds and forms partially inactive or less effective byproducts.

Mechanisms of Microbial Efficacy

Bio-G-Active achieves its antimicrobial efficacy through a **biologically enhanced process**, which supports the natural degradation of microflora on the meat surface. Its mechanism of action can be broken down into three phases:

1. Phase One – pH Reduction:

- The components of Bio-G-Active, including organic acids such as lactic acid, significantly lower the pH on the meat surface. A lower pH inhibits bacterial growth, as most pathogenic microorganisms thrive in neutral or slightly alkaline conditions. By reducing the pH, cell reproduction is suppressed, and the cells become more vulnerable to destruction.

2. Phase Two – Bactericidal Effect:

- Bio-G-Active penetrates the cell membranes of microorganisms, leading to their destruction. This effect is amplified by the synergistic combination of lactic acid, phosphates, and ascorbic acid. Chlorine, on the other hand, only targets the outer cell layers and is inactivated by organic matter on the meat surface, reducing its efficacy.

3. Phase Three – Complete Biodegradability:

- All components of Bio-G-Active are **biodegradable**, leaving no harmful residues. This contrasts with chlorine, which, when reacting with organic matter, can form toxic byproducts such as organochlorine compounds, which are suspected of being carcinogenic.

Sensory Advantages of Bio-G-Active

In addition to its superior microbial efficacy, Bio-G-Active offers distinct advantages regarding the **sensory quality** of treated meat. The sensory properties of a product, particularly in the poultry industry, are crucial for consumer acceptance.

1. Improved Browning and Texture:

- Meat treated with Bio-G-Active shows a **marked improvement in browning** and a **crispier skin** after preparation. This is especially beneficial for roasted or grilled poultry, where the color and texture of the skin play a critical role in consumer purchasing decisions. Chlorine-treated carcasses, on the other hand, often exhibit a paler appearance, which is perceived as a lower-quality attribute.

2. Enhanced Sensory Quality:

- In several sensory tests assessing skin consistency, taste, and odor, Bio-G-Active outperformed chlorine significantly. Chlorine-treated samples were often described as "dry" or "bitter," while Bio-G-Active-treated carcasses exhibited a juicier texture and more pleasant flavor. This is particularly relevant for the food industry, where taste and texture are key factors in product success.

No Harmful Residues: A Key Advantage Over Chlorine

One of the major disadvantages of chlorine is the potential for the formation of harmful residues, particularly organochlorine compounds. These compounds, formed when chlorine reacts with organic matter, are potentially **carcinogenic and harmful** to human health. In the EU and many other regions, strict regulations are in place to minimize such residues in food products.

- **Bio-G-Active leaves no residues** on the meat surface. All of its components, including organic acids and phosphates, are biodegradable, leaving no harmful substances in the final product. This makes Bio-G-Active a safer choice for food safety.

Environmental and Health Considerations

Another significant advantage of Bio-G-Active over chlorine lies in its **environmentally friendly properties**. Chlorine-based solutions used in poultry processing must be carefully disposed of due to the formation of potentially hazardous byproducts. These byproducts, such as organochlorine compounds, are not only harmful for human consumption but also pose a **significant environmental burden**.

- Bio-G-Active requires no special disposal measures, as it is biodegradable and leaves no toxic residues. This reduces the costs and risks associated with the disposal of chlorine-laden wastewater and significantly decreases the environmental impact of poultry production.

Summary of Advantages

Bio-G-Active offers several clear and comprehensive advantages over chlorine:

1. **Superior microbial efficacy:** Bio-G-Active more effectively reduces microorganisms, particularly dangerous pathogens like *Salmonella* and *Escherichia coli*, compared to chlorine. Through significant reduction in the total bacterial count and inhibition of bacterial growth on the meat surface, Bio-G-Active provides a far safer method of decontamination. Unlike chlorine, which is less effective in the presence of organic material, Bio-G-Active remains stable and effective under such conditions.
 2. **No harmful residues:** Chlorine can react with organic matter to form dangerous byproducts such as organochlorine compounds, which are considered hazardous to health. In contrast, Bio-G-Active leaves no residues on treated meat, as all its components are biodegradable. This makes Bio-G-Active a safer option for consumers and increases food safety.
 3. **Improved sensory properties:** Bio-G-Active significantly enhances the sensory qualities of treated poultry. Sensory tests show that Bio-G-Active-treated carcasses exhibit more consistent and appealing browning, as well as firmer and crispier skin. These characteristics are important to consumer perception, as they indicate higher product quality. Chlorine-treated samples, on the other hand, tend to be paler and less crispy, often perceived as lower quality.
 4. **Environmentally and health-friendly:** Chlorine has numerous negative environmental effects. Disposal of chlorine-laden wastewater requires special treatment to prevent the release of harmful substances. In contrast, Bio-G-Active is fully biodegradable and can be safely released into wastewater systems, reducing both the cost and complexity of disposal while minimizing environmental risks.
 5. **No formation of harmful byproducts:** A significant drawback of chlorine treatment is the formation of toxic byproducts that can penetrate the meat and potentially pose health risks. Bio-G-Active contains only natural or biodegradable substances that do not generate harmful byproducts, making it particularly valuable in markets with strict food safety regulations, such as the EU and other regions.
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Scientific Mechanism of Antimicrobial Action of Bio-G-Active

The superior efficacy of Bio-G-Active is based on a **multi-phase biological process** that not only decontaminates the meat surface but also supports the natural physiological processes that occur during meat maturation. The mechanism of action can be described as follows:

1. **pH Reduction:**
 - Bio-G-Active contains organic acids, such as lactic acid, that significantly lower the pH on the meat surface. This pH reduction is crucial because most pathogenic microorganisms, such as *Salmonella* and *E. coli*, thrive in neutral or slightly alkaline environments. By lowering the pH, the reproduction rate of these bacteria is drastically reduced, hindering their growth and making the bacteria more susceptible to elimination.
2. **Synergistic Action of Ingredients:**
 - The combination of lactic acid, phosphates, and ascorbic acid in Bio-G-Active creates a **synergistic antimicrobial effect**. These components interact to create an environment that is hostile to the survival of pathogenic

microorganisms. This synergy is a key factor that gives Bio-G-Active its superior efficacy compared to chlorine, which lacks such synergistic properties.

3. Destruction of Bacterial Cell Membranes:

- Bio-G-Active not only inhibits bacterial growth but also has a **direct bactericidal effect**. It penetrates the cell membranes of bacteria, causing structural damage that leads to their destruction. This effect is particularly potent against gram-negative bacteria, such as *E. coli* and *Salmonella*, which have more complex outer membranes. In contrast, chlorine primarily acts on the outer cell layer and loses its effectiveness due to interactions with organic matter.

4. No Impact on Sensory Quality:

- Unlike chlorine, which can negatively affect the sensory quality of meat, Bio-G-Active preserves the **natural texture, flavor, and aroma** of the meat. This is a significant advantage for consumer acceptance, as the sensory properties of food products play a critical role in market success.

Comparative Assessment of Microbial Reduction

In scientific studies that directly compared the efficacy of Bio-G-Active and chlorine, Bio-G-Active demonstrated superior results across all relevant microbial categories:

- **Total Bacterial Count (TBC):** Bio-G-Active reduced the total bacterial count by up to three log cycles, while chlorine achieved a reduction of only up to one and a half log cycles.
- **Reduction of Enterobacteriaceae and *Staphylococcus aureus*:** Bio-G-Active significantly reduced the levels of Enterobacteriaceae and *Staphylococcus aureus* more effectively than chlorine, particularly after several days of storage.
- **Reduction of *Salmonella* spp.:** Bio-G-Active was far more effective than chlorine in inhibiting the growth and eliminating *Salmonella*. In some cases, *Salmonella* was no longer detectable in samples treated with Bio-G-Active after storage.

Conclusion: Scientifically Validated Advantages of Bio-G-Active

In conclusion, Bio-G-Active offers a number of scientifically validated advantages over chlorine:

1. **Significantly higher microbial efficacy:** Bio-G-Active effectively reduces microbial contamination, particularly dangerous pathogens such as *Salmonella* and *E. coli*, far more efficiently than chlorine.
2. **No harmful residues:** Unlike chlorine, which can leave behind residues that are potentially harmful, Bio-G-Active leaves no residues on treated meat, making it a safer option for the food industry.
3. **Improved sensory properties:** Bio-G-Active enhances the texture, flavor, and appearance of treated meat, leading to greater consumer acceptance.

4. **Environmentally friendly and safe for health:** Bio-G-Active is fully biodegradable and leaves no harmful byproducts, making it a more eco-friendly alternative to chlorine.
5. **Safer application and handling:** Chlorine poses health risks during use, particularly due to the formation of toxic fumes. In contrast, Bio-G-Active is safe to use and does not present such hazards.

By combining these factors, Bio-G-Active represents a superior solution for the decontamination of poultry carcasses, offering significant advantages in terms of food safety, sensory quality, and environmental impact compared to chlorine.

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