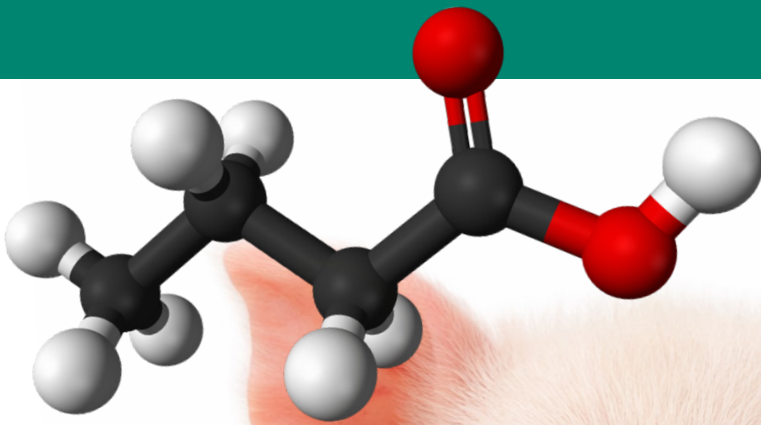


Stabilized butyrate technology to optimize intestinal health from the earliest stages of production



Intestinal health is a key factor for **productive efficiency** in intensive animal production systems.



In **monogastric species** such as pigs and poultry, the gastrointestinal tract not only participates in the digestion and absorption of nutrients, but also acts as an important **barrier against pathogens** and as a **regulator of metabolic and immunological processes**.

In this context, short-chain fatty acids (SCFAs), and especially butyric acid, have become increasingly relevant in animal nutrition due to their beneficial effects on the intestinal mucosa, the microbiota, and the metabolism of the digestive epithelium.



Butyrate is a **major energy source** for enterocytes, promoting the development of intestinal villi, the integrity of the intestinal barrier, and nutrient absorption.



However, its **practical application** in animal nutrition presents certain **technological and physiological challenges** that have driven the development of different strategies to protect butyrate and control its release in the gastrointestinal tract.

BUTYRATE IN ANIMAL NUTRITION: LIMITATIONS OF CONVENTIONAL TECHNOLOGIES

Pure **butyric acid** presents significant **drawbacks** for **industrial use**: it is highly volatile, corrosive, and has an extremely intense odor that makes its handling in feed mills difficult. For this reason, it is commonly used in **animal nutrition** in the form of **butyrate salts**, primarily **sodium or calcium butyrate**.



Aiming to improve stability and target its release in the gastrointestinal tract, various **protection technologies** have been developed, notably:

- **Fat-encapsulated butyrates.**
- **Butyrates encapsulated in protein or carbohydrate matrices.**
- **Esterified butyrates (mono- and tributyrins).**

These **solutions** mainly seek to **delay the release of butyric acid until the distal intestine**. However, they present a **significant physiological limitation**: many of them rely on the activity of digestive enzymes, especially pancreatic lipases, to release the active butyrate.



This aspect becomes **particularly relevant in young animals**, whose digestive system has not yet reached full functional maturity.



Several studies have demonstrated that digestive enzyme activity in neonatal or recently weaned animals is considerably lower than that observed in adult animals. In the **case of piglets**, for example, pancreatic lipase activity during the first weeks of life is limited and increases progressively with age (*Li FC. et al., 2001*).

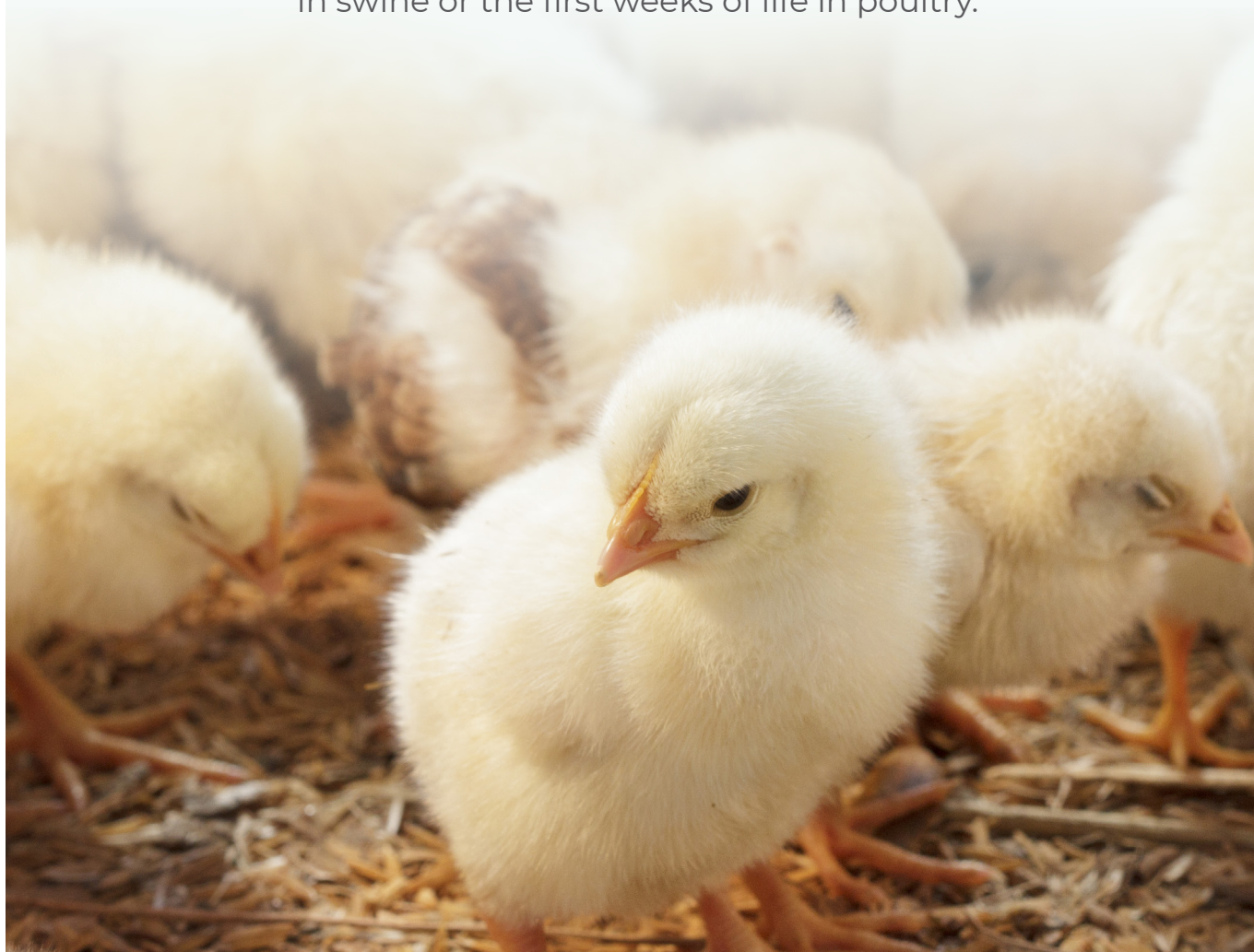
In fact, research on the enzymatic development of the pancreas indicates that **lipase activity is low** during the **first weeks of life** and **increases** significantly **from 3-4 weeks of age**.

- Likewise, after **weaning**, a **progressive adaptation of the exocrine pancreas to the new solid diet** is observed, with temporary reductions in the activity of digestive enzymes such as lipase or trypsin during the first days post-weaning (*Marion et al., 2003*).



A similar phenomenon occurs in **poultry**. The **digestive system of newly hatched chicks** is still immature, and the activity of digestive enzymes, including pancreatic lipase, **increases progressively during the first days post-hatch** as the gastrointestinal tract develops (*Noy & Sklan, 1995; Uni et al., 1998*).

- This **physiological phenomenon implies** that products whose release depends on lipases **may not release butyrate efficiently precisely in the stages when its use is most needed**, such as the early post-weaning period in swine or the first weeks of life in poultry.



THE NUTRITIONAL CHALLENGE IN YOUNG ANIMALS

The early productive phases represent one of the most critical periods in animal production.



In **piglets, weaning** poses a **severe nutritional, immunological, and physiological challenge**. The sudden shift from a liquid to a solid diet, coupled with the immaturity of the digestive system, favors the onset of digestive disorders, intestinal dysbiosis, and losses in productive efficiency.



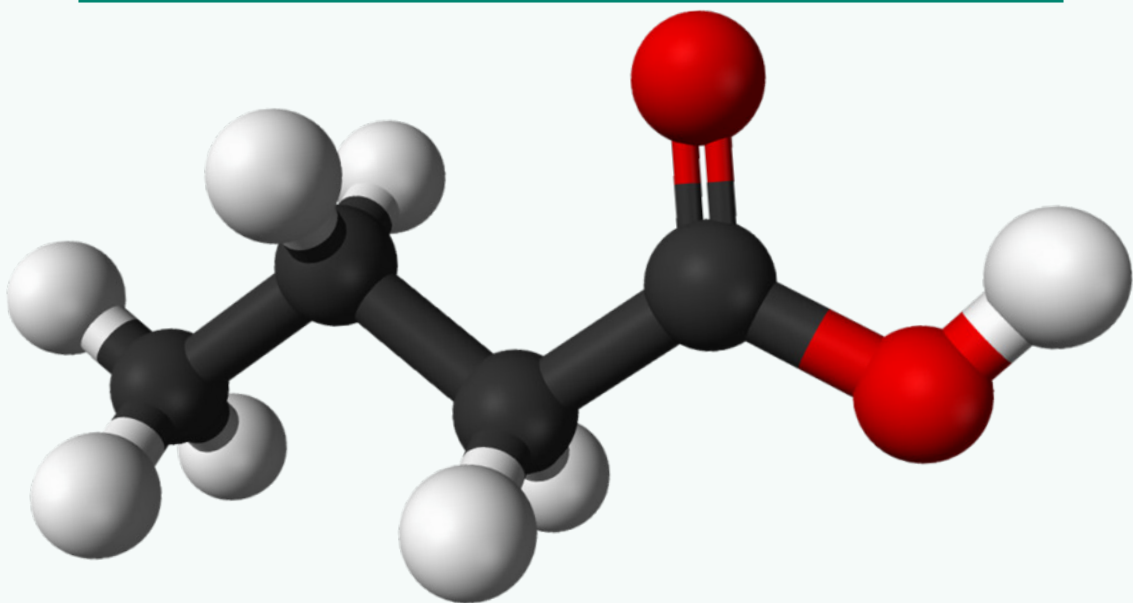
In **poultry farming**, chicks similarly present a developing digestive system during their first days of life, which **limits their digestive capacity and increases their susceptibility to enteric pathogens**.



In this context, the **provision of exogenous sources of butyric acid** is particularly **interesting** to:

- ☞ stimulate intestinal development
- ☞ improve mucosal integrity
- ☞ promote microbiota balance
- ☞ increase digestive efficiency

Nevertheless, for these **benefits to materialize, it is essential that the butyrate is efficiently released in the digestive tract** without relying on the animal's enzymatic activity.



BUTYRON: A NEW PROTECTION TECHNOLOGY – STABILIZATION

With the aim of overcoming the limitations of conventional technologies, **IGUSOL Advance** has developed **BUTYRON**, an **innovative source of sodium butyrate** stabilized with calcium carbonate salts through a multilayer manufacturing technology.

→ **BUTYRON** contains **60% stabilized sodium butyrate** and is presented in the **form of microbeads**, obtained through a progressive mineral coating process.

Unlike systems based on lipid encapsulation or esterification, **BUTYRON's technology does not use fat matrices or glycerol bonds**, which **avoids the dependence on digestive enzymes for the release of the active ingredient.**



PROGRESSIVE RELEASE WITHOUT ENZYMATIC DEPENDENCE

One of the main **advantages** of this technology is that **butyrate release does not depend on pancreatic lipases**.

→ While fat-encapsulated butyrates or tributyrins require the action of intestinal lipases to release butyric acid, **BUTYRON** begins its **release** simply upon **contact with digestive fluids and the pH of the gastrointestinal tract**.

This has several important physiological implications:

1. Greater efficacy in young animals

Due to the immaturity of the digestive system in the early productive stages, pancreatic lipase activity is limited. Therefore, **products requiring lipase may release insufficient amounts of butyrate**.



BUTYRON bypasses this limitation, allowing butyrate to be available from the early segments of the digestive tract.

2. Release in both proximal and distal segments

Encapsulated products typically **release butyrate** mainly in the **distal intestine**, losing part of the benefits associated with its action in the upper gastrointestinal tract.

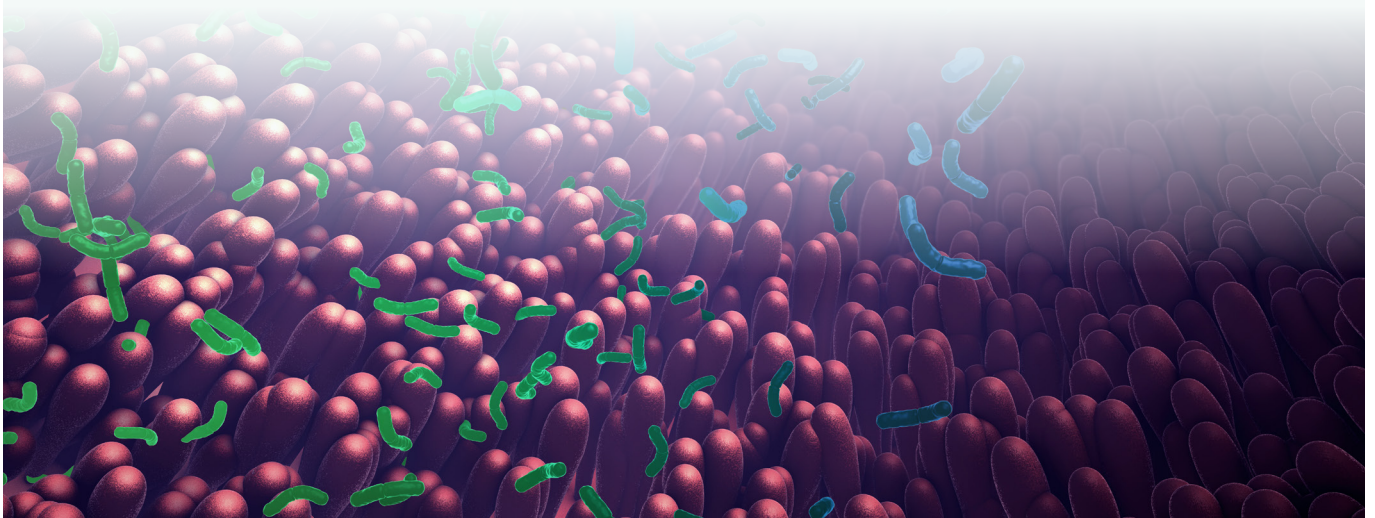


BUTYRON, thanks to its mineral stabilization technology, features a **mixed release pattern**, allowing activity in:

- stomach / proventriculus
- proximal intestine
- distal intestine



This promotes a more comprehensive action on the microbiota, intestinal integrity, and digestibility.



3. Improved stability and handling

Unprotected sodium butyrate presents **issues with volatility, corrosiveness, and strong odor.**

The stabilized microbead technology allows for:

-  significantly reducing odor
-  improving handling in feed mills
-  improving homogeneity in the feed

PROVEN PRODUCTIVE BENEFITS

The **effects of butyric acid** on **intestinal health** are widely documented. Among its main **benefits** are the **stimulation of intestinal mucosa development**, by acting as an energy source for enterocytes and promoting villus growth;



the **strengthening of the intestinal barrier** by increasing tight junction proteins and mucin production; the **modulation of the intestinal microbiota**, with activity against pathogens such as *Salmonella* or *Clostridium*; and its **anti-inflammatory effect** by reducing the production of pro-inflammatory cytokines.

In **productive terms**, various **trials with BUTYRON** have **shown improvements in parameters such as final weight, feed conversion ratio (FCR), feed intake, and productive efficiency.**



In **broilers**, an improvement in the European Production Efficiency Factor (EPEF) has been observed compared to other butyrate sources, while in **weaned piglets**, higher weight gains and better feed conversion have been recorded, leading to greater economic profitability.

A SOLUTION ADAPTED TO THE CHALLENGES OF MODERN PRODUCTION

Current animal production demands nutritional tools that improve productive efficiency while reducing antibiotic use and optimizing intestinal health.



In this context, **organic acids**, and **butyric acid** in particular, play an increasingly relevant role.



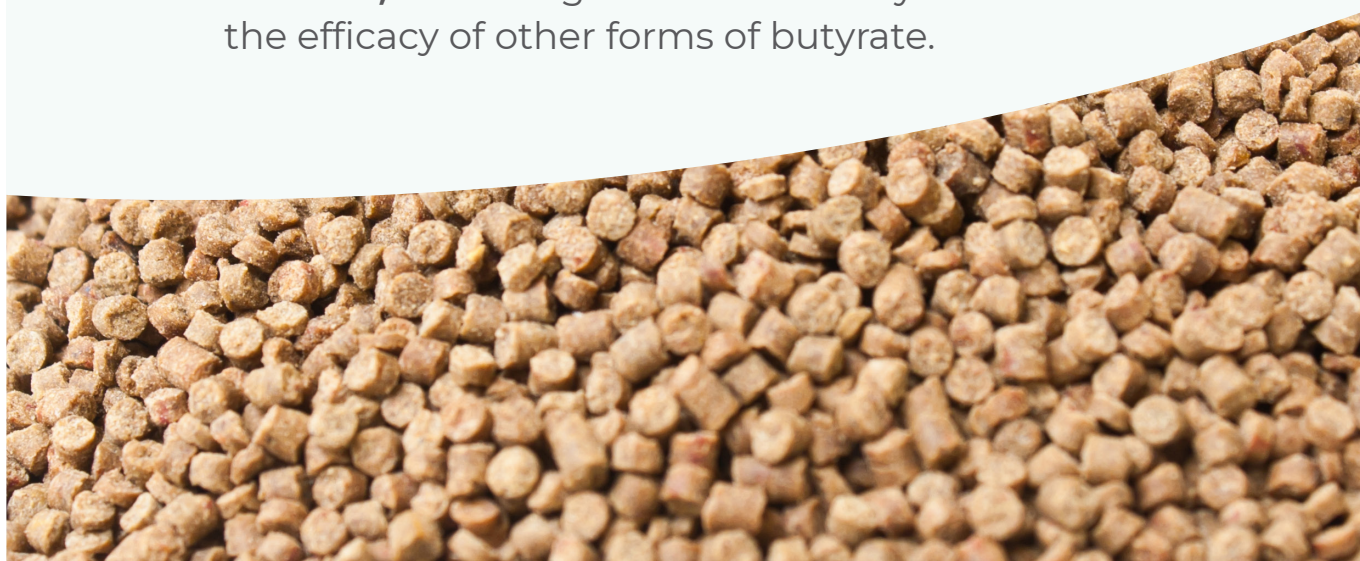
However, the **efficacy** of these solutions **depends** heavily on their **release technology** and their **ability to adapt to the animal's digestive physiology**.

The **multilayer stabilization technology** of **BUTYRON** represents an innovative approach that **combines**:



- > high concentration of sodium butyrate
- > progressive release in the digestive tract
- > absence of enzymatic dependence
- > excellent handling in the feed mill

These characteristics make **BUTYRON** a **particularly interesting tool for young animals**, where digestive immaturity can limit the efficacy of other forms of butyrate.



CONCLUSION



Butyric acid is one of the most widely used additives to improve intestinal health and productive performance in monogastrics, although its efficacy depends heavily on the protection technology used.



BUTYRON introduces an innovative solution based on the stabilization of sodium butyrate with layers of calcium carbonate, enabling a progressive release throughout the gastrointestinal tract without relying on digestive enzymes.

This feature makes it a particularly effective tool in young animals, promoting intestinal health and productive efficiency.



