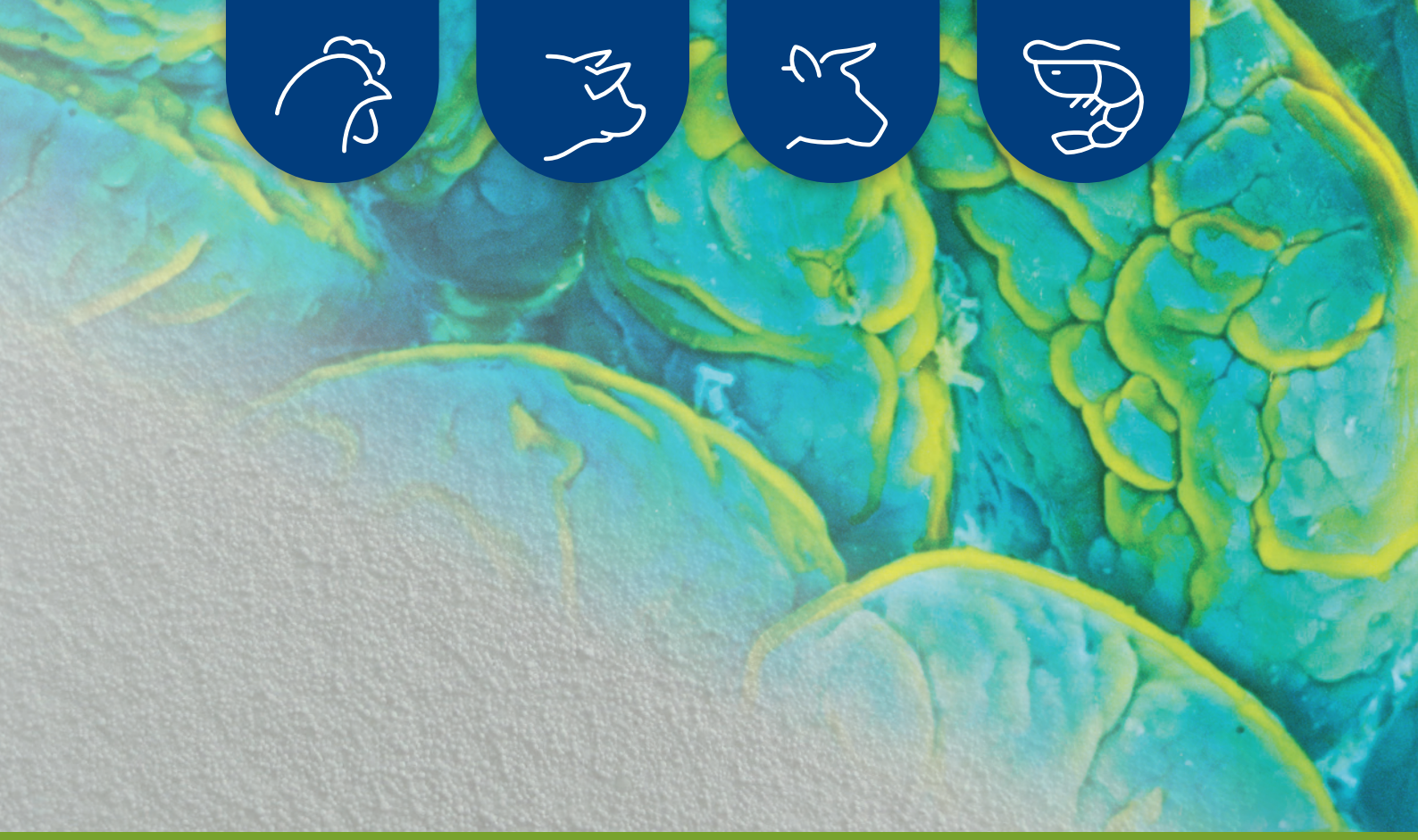


Fuel the gut AND support its barrier
Target release of bio-active butyrate

Novyrate® EB

Gut-Active Esterified Butyrins

innovad®
CREATE TRUST

Novyrate® EB

Gut-Active Esterified Butyrins

Butyric acid, the optimal solution to support gut integrity

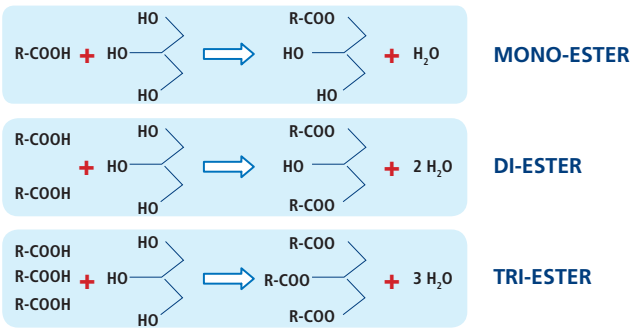
Butyric acid is a short chain fatty acid naturally produced by bacteria in the upper digestive tract mainly by the fermentation of fibers. The fatty acid is considered the most important energy source for intestinal cells (colonocytes) and exerts multiple beneficial effects on vital intestinal functions. As butyric acid fermentation in young animals is limited, supplementation is beneficial for the development and maturation of the digestive tract. However, the supplemented butyric acid should be available beyond the stomach, and should reach the upper intestine.

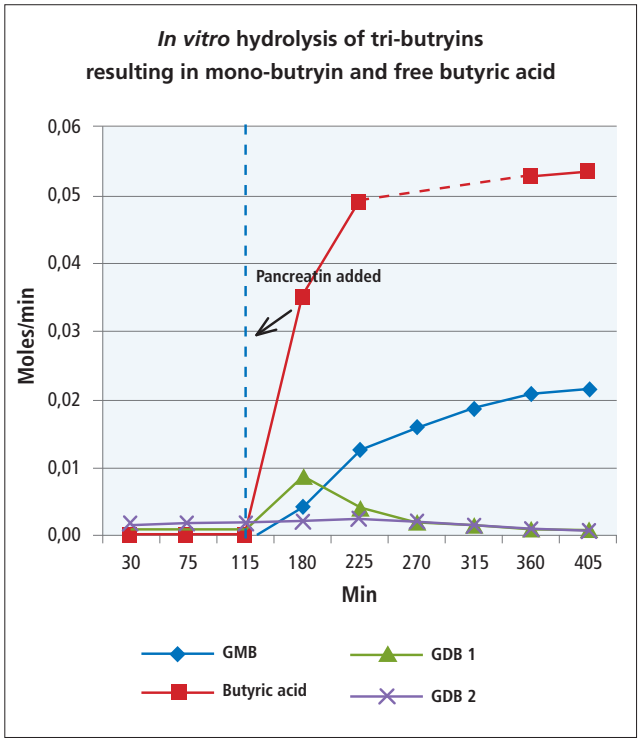
	BUTYRIC ACID MODE OF ACTION	BUTYRIC ACID BENEFITS
Absorption	Energy source for epithelial cell development → Stimulating growth of villi + numbers of micro-villi + digestive enzyme secretions	Increases absorptive capacity of small intestine + nutrient digestibility
Microbiota	Balances microbiota with selective control of pathogens and modulation of microbial composition of the gut (by stimulating proliferation of beneficial bacteria + inhibiting development of pathogenic bacteria)	Enhances the ability of the animal to deal with, and recover from,- bacterial infections
Intestinal barrier	Enhances intestinal barrier by facilitating tight junction assembly + limiting bacterial translocation	Inhibits passage of harmful bacteria & toxic compounds through enhancement of the epithelial layer + protects invasion in blood stream
Signaling molecule	Acts as a signaling molecule	Regulates digestive hormones
Anti-bacterial	Exerts direct antibacterial effect & limits the invasiveness of key pathogens such as *Salmonella Typhimurium* by down-regulating invasion genes (HIL-A)	Reduces pathogenic bacterial colonization + inflammation pressure
Anti-inflammatory	Exerts potent anti-inflammatory effect	Saves energy by suppressing inflammation
Immunity	Enhances synthesis of endogenous antimicrobial Host Defense Peptides (HDP) which in turn disrupt the cell membrane of pathogens and limit their adhesion to the gut wall	Enhances non-specific intestinal immunity
Antioxidant	Increases glutathione production by colonocytes	Protects from oxidative stress + decreases oxidative injury of tissues
Meat Quality	Modulates hepatic expression of genes associated with lipid metabolism	Improves fat metabolism & lowers abdominal fat deposition, as well as fat deposition in the breast muscle

Gut-active esterified form of butyric acid

Esterified butyrins are combined molecules composed out of a glycerol structure and butyrate molecules which act as a source of butyric acid in the intestinal tract. The final result of the esterification reaction is mono-, di- or tributyrins with 1, 2 or 3 butyrate molecules, respectively.

Based on the molecules origin, it is easy to understand that these "fat-type" structures can only be digested in the presence of the digestive enzyme lipase. By definition, this guarantees full stomach bypass whilst activation occurs only upon release of pancreatic lipase.





Esterification process, key for product quality

To guarantee the desired stability of the end product the esterification reaction needs to be controlled precisely. This way both the desired shelf life and full potential during application are guaranteed.

Raw materials → Catalyst → Purification → Dehydration

Determining factors of the esterification process:

1. High quality and purity of **raw materials**.
2. Selection of the correct **catalyst** which speeds up the reaction, and sequesters water.
3. Optimum **purification**: Removing completely the catalyst.
4. **Dehydration:** as water can reverse the esterification reaction, removing it will lead to a stable product.
5. **Quality Control** of End Product: Reversed reaction will result in glycerol and free acid. This can easily be detected by analysis of the acid value of the product.

Novyrate® EB features

A. Unique formulation combining mono di & tributyrins

Innovad's expertise and chemistry knowledge guarantees a highly concentrated and pure product with high shelf-life and stability during pelleting and extrusion processes, without the typical smell of butyric acid.

Mono-esters	Di-Tri esters
• pH stable (+ passes the stomach)	• pH stable (+ passes the stomach)
• Small molecule (+ easy uptake by bacteria leading to internal hydrolysis and effective anti-bacterial activity)	• Bigger molecule (no bacterial uptake)
• 1 side chain only (+ escape from endogenous lipase)	• 2 or 3 side chains (hydrolysis by endogenous lipase)
• No supply of butyrate	• High supply of butyrate (+)

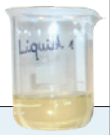
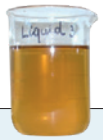
Novyrate® EB combines butyrate supply (quantity) and strong activities (quality)

MIC	*S. Typhimurium*	*E. Coli*
Butyric acid	1:400	1:400
Mono-esterified butyrins	1:1600	1:800
Outcome:	Mono EB = 4x higher activity than Butyrate	Mono EB = 2x higher activity than Butyrate

Innovad, 2012

B. Chemical stability

A high quality product is a clear liquid, low in moisture content, contains no catalyst after the esterification process and is low in acid value.

	LIQUID 1	LIQUID 2	LIQUID 3	LIQUID 4
	Competitor A	Competitor B		Innovad®
				
Liquid	Light coloured	Dark coloured – layer separation	Coloured	**Clear**
Moisture (KF) %	0,17	0,69	1,38	**0,14**
S (ppm)	0,25	0,96	0,72	**ND**
Acid value (mg KOH/g)	0,25	0,96	0,72	**0,05**

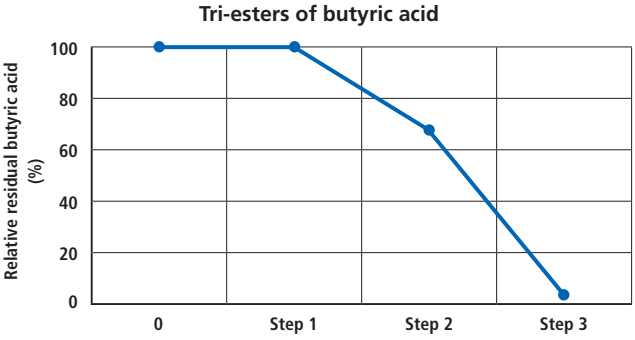
C. Heat stability

The free and total butyric acid content (BA) of the esters were evaluated with HPLC method before and after heating. Samples were heat treated in an open recipient oven with a 'contact surface area' of 64cm². Results shown are the mean values of repeats.

	Standard values	Before test	1 min at 90°C	5 min at 90°C	1 min at 120°C	5 min at 120°C
Mono-esters of butyric acid						
Free BA (%)	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5
Total BA (%)	31,5 – 38,5	38,1	38,2	39,2	37,9	38,3
Tri-esters of butyric acid						
Free BA (%)	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5
Total BA (%)	76,5 – 93,5	87,6	85,0	85,2	87,1	87,6

D. Target release properties (Boisen test)

The product is tested with an in-vitro method intended to mimic the digestion of target release products in the gastro-intestinal tract (stomach and 1st + 2nd compartment of the intestine) with a three-step enzymatic incubation. After each step, the butyric acid that was liberated was quantified, expressed as Relative residual butyric acid (%).



Novyrate® range

Novyrate® EB range is:

- Free-flowing
- With NO smell
- Non-corrosive (no ADR)
- Heat stable
- Target release

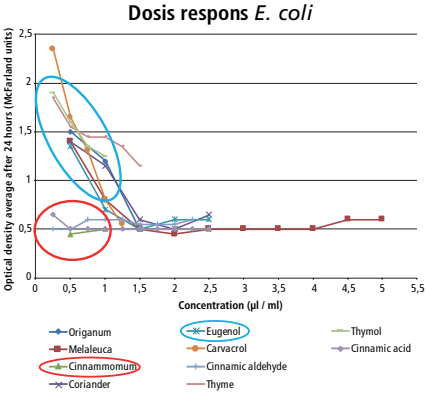
Novyrate® EB

combines butyrate supply (quantity) and strong antibacterial activities (quality).

Novyrate® EB Plus

combines butyrate supply (quantity) and strong antibacterial activities (quality) with **additional essential oils to enhance its antibacterial activity.**

Dosis respons *E. coli*



Dosage and application

Poultry: From 0,250 to 1,000 kg/T

Pig: From 0,500 to 2,000 kg/T

Calf: From 2 to 5 g/head/day

Aqua: From 1,000 to 3,000 kg/T

Trials

Field trial – Avian

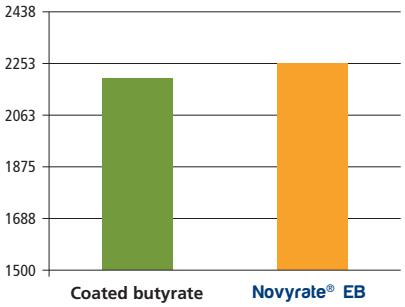
Broilers: ROSS 308, 3,000 per group
Duration of the trial: 41 days

Trial protocol

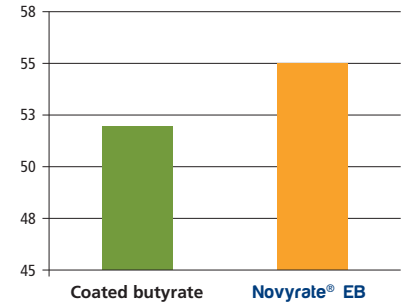
Period	Coated butyric acid	Esterified butyric acid
Starter	Regular feed + Coated butyrate (1 kg/T)	Regular feed + Novyrate® EB (1 kg/T)
Grower	Regular feed + Coated butyrate (0.7 kg/T)	Regular feed + Novyrate® EB (0.7 kg/T)

Results:

Body weight gain (g)



Daily gain (g)



University trial – Swine

Duration of the trial:
Day 21 (weaning) - Day 67 of age

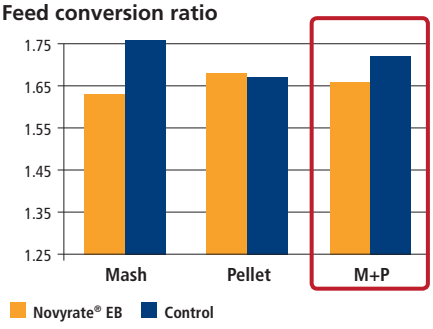
Trial protocol

Feed type:
Mash feed & Pelleted feed (Ø 2.3mm)

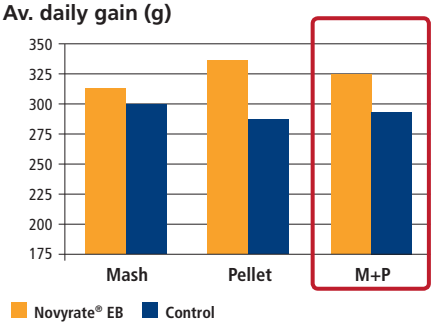
Period	Control	Trial
Weaning stage (21 – 35 days)	Regular feed	Regular feed + Novyrate® EB (2 kg/T)
Prestarter feed (35 – 67 days)	Regular feed	Regular feed + Novyrate® EB (1 kg/T)

Results:

Feed conversion ratio



Av. daily gain (g)



Please contact our technical services for detailed application

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