

Feed additives and *Salmonella* mitigation



Salmonella and biosecurity

Salmonella is a well-known challenge in animal production and beyond, as the bacterium is mainly known as the causative agent of salmonellosis in humans. Despite a lot of efforts from different actors in the farm-to-fork chain, salmonellosis remains firmly in the top three of most common zoonotic diseases worldwide.

Biosecurity management

To control and reduce the risk of *Salmonella* down the line, implementing a good biosecurity management plan on-farm is essential. This overall plan should include general biosecurity, as well as supporting the animal from within.

A good biosecurity management plan is not only relevant in production downtime: general measures must be continuously in place and respected at all times. In general, there are three distinct parts of a proper biosecurity plan*:

1. General biosecurity at all times

- ▶ External: including pest control, wild animal access and any incoming traffic on the premises
- ▶ Internal: including sanitary locks, foot dips, general sanitation measures and on-site biosecurity monitoring

2. Biosecurity in between production rounds

The complete premises and any moveable equipment should be cleaned, sanitised and disinfected between production rounds. This will reduce the risk of biosecurity challenges during production. In general, seven stages can be distinguished:

- ▶ Stage 1: cleaning and disinfecting the drinking system
- ▶ Stage 2: removal of organic matter and equipment
- ▶ Stage 3: cleaning and sanitising
- ▶ Stage 4: initial disinfection
- ▶ Stage 5: sanitary break
- ▶ Stage 6: reintroduction equipment and new litter
- ▶ Stage 7: final disinfection

3. Water quality management

- ▶ Monitor water quality parameters such as pH, hardness and bacterial load
- ▶ Apply regular flushing and install mineral filters
- ▶ Follow the proper application guidelines when introducing vet meds or feed additives via the drinking water system.
- ▶ Apply water sanitation measures

* For more information on general biosecurity, available hygiene products and water quality management, contact your local Huvepharma representative.



Biosecurity within the animal

Salmonella and butyrate

Apart from external biosecurity, there are tools available to mitigate *Salmonella* within the animal as well.

As described by Rivera-Chávez *et al.* (2016), faecal-oral *Salmonella* expansion and transmission is fuelled by available oxygen in the hindgut:

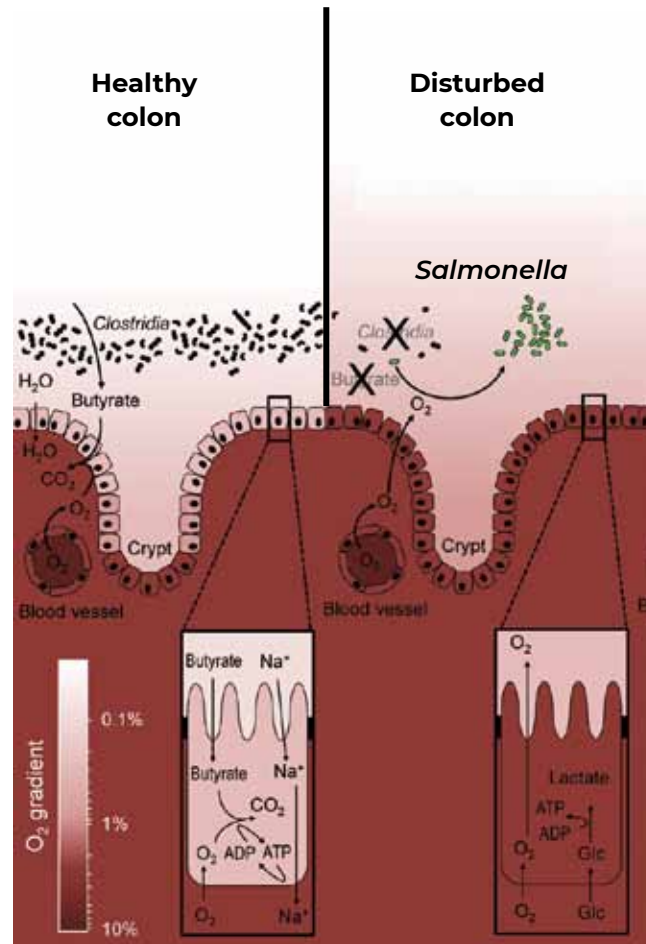


Figure 1. Changes in energy production in the absence of butyrate can lead to accelerated *Salmonella* proliferation, as oxygen becomes more available in the lumen (adapted from Rivera-Chávez *et al.*, 2016)

Normal situation: butyrate present

Commensal Clostridia produce butyrate, which is utilised together with oxygen in the colonocytes' energy production. This prevents excess oxygen from being released into the lumen.

High-risk situation: no butyrate present

In the absence of butyrate, colonocytes use glucose for their energy production. Oxygen is not utilised in this process. Instead, excess oxygen is released into the lumen.

Getting butyrate to the right location

The level of butyrate in the hindgut will heavily influence the expansion and transmission of *Salmonella*. Consequently, ensuring sufficient butyrate at that location is key to restrict *Salmonella* on-farm. However, traditional butyrate forms usually do not reach these later stages of the gastro-intestinal tract. This is where Top Gut[®] and Top Gut[®] WSP can help, delivering a unique strain of probiotic *Clostridium butyricum* where it is most needed.

Top Gut[®] and Top Gut[®] WSP

Top Gut[®] and Top Gut[®] WSP can be easily incorporated in the biosecurity protocol, respectively via the feed or the drinking water.

1. Characteristics

Top Gut[®] and Top Gut[®] WSP contain viable spores of a single and unique *Clostridium butyricum* strain. The probiotic strain is a Gram-positive, strict anaerobic, spore-forming bacteria, ensuring stability in storage, feed processing, drinking water and within the animal.

2. Mode of Action

Clostridium butyricum's mode of action is multifactorial:

► Obligate anaerobe, spore-forming probiotic

The spores reach the hindgut unscathed, where oxygen concentrations are low enough to germinate. This location is often not reached by traditional feed additive butyrates.

► Active oxygen scavenger

The strain can reduce oxygen concentrations in its immediate surroundings, reducing the oxygen concentrations further.

► Production of short-chain fatty acids, such as butyric acid

Apart from being a good energy source for the colonocytes and utilising oxygen in the process, butyrate is known to increase nutrient digestibility, modify the intestinal microbiota, improve epithelial integrity and stimulate immunity.

As a result of the above, *C. butyricum* has the capacity to reduce free oxygen. It does so in the hindgut, exactly where *Salmonella* would benefit from an increased oxygen concentration. As such, Top Gut[®] and Top Gut[®] WSP suppress *Salmonella* expansion and transmission in farm animals.

3. In vivo results

a. Producing butyrate at the right location

When Ross 308 broilers received Top Gut[®] in their feed from day 0 to 42, the amount of butyrate in their caecum was significantly higher compared to animals in the control group ($P < 0.05$, Figure 2).

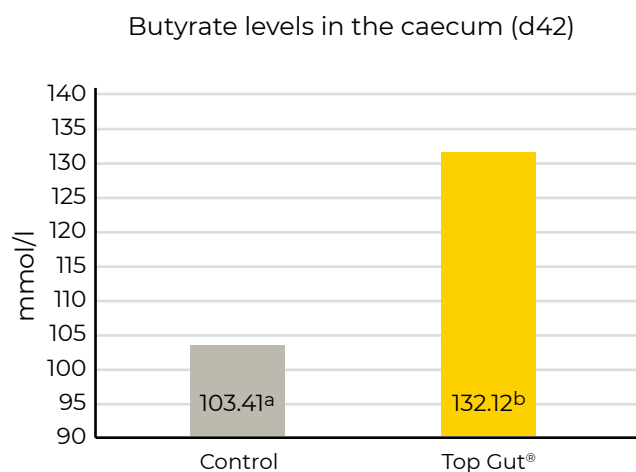
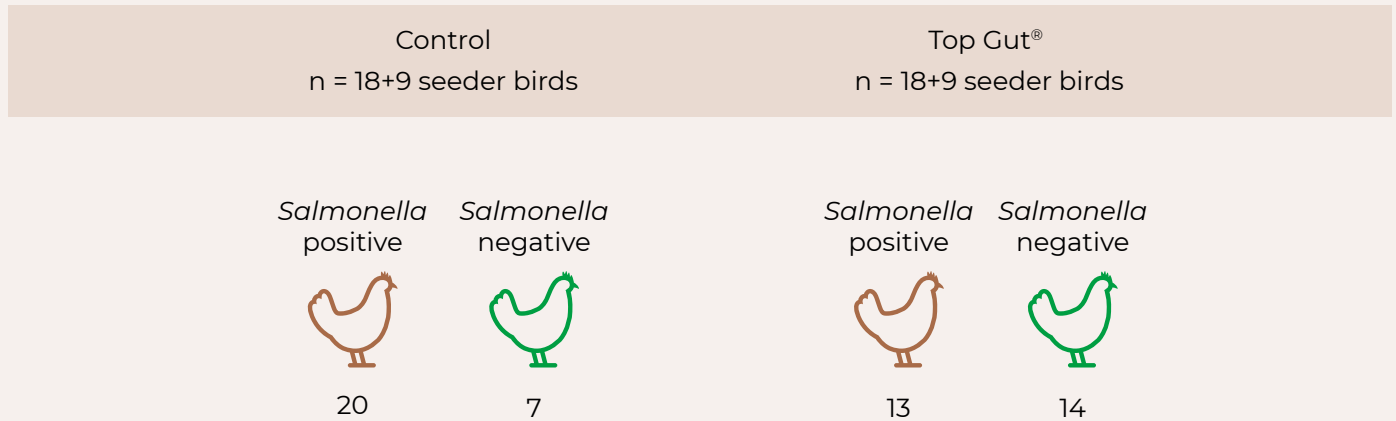


Figure 2 Butyrate levels in the hindgut of broilers with or without Top Gut[®] in the feed.

b. Mitigating *Salmonella* on-farm

When broilers were challenged with *S. Enteritidis* at day 5 in a seeder model, the groups supplemented with Top Gut® from day 0 showed fewer positive animals on day 15.



Average *Salmonella* titres (in terms of logCFU/gram per caeca) were also considerably lower for animals receiving Top Gut® compared to the control (Figure 4).

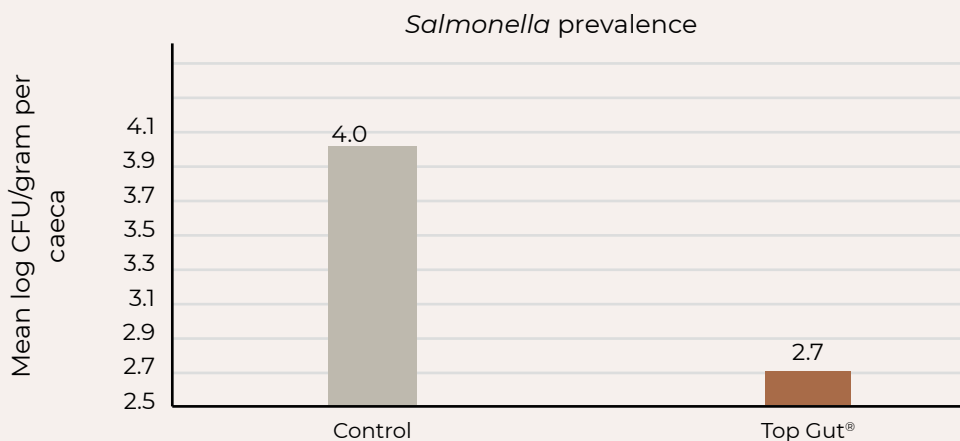


Figure 4. Mean logCFU/gram per caeca on day 15 for animals challenged with *S. Enteritidis* on day 5, with or without receiving Top Gut®

Probiotics

Probiotics have been defined as viable organisms which beneficially affect the host animal, if present in adequate amounts, often via a multifactorial mode of action. This includes improving the animal's intestinal microbial balance. Achieving a balanced gut microbiota is critical to intestinal health because of the effect of bacteria on gut morphology, nutrition, intestinal disease and immune responses.



Dose recommendations

Species	CFU <i>Clostridium butyricum</i> /g Top Gut®	Recommended dose of Top Gut®/mton of feed	CFU <i>Clostridium butyricum</i> /mton of feed
Poultry	5*10 ⁸	0.5 kg	2.5*10 ¹¹
Turkeys	5*10 ⁸	0.25 kg	1.25*10 ¹¹

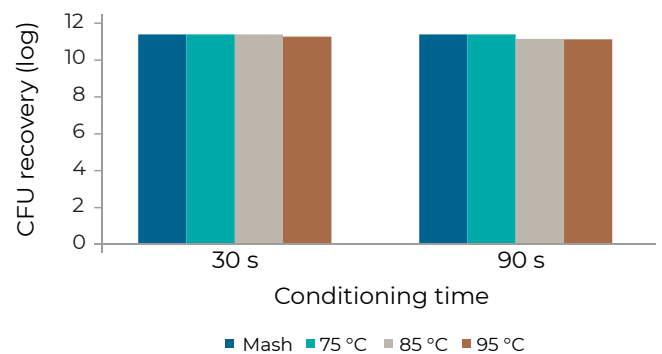
Top Gut® WSP dosages depend on age - contact your Huvepharma representative for more information.

Stability

Thanks to its spore-forming ability, *Clostridium butyricum* can resist a wide variety of challenging environmental conditions. This includes those in drinking water on-farm as well as different conditions during feed processing.

As such, Top Gut® and Top Gut® WSP remain stable during feed processing, storage and digestion.

Top Gut® stability during feed processing



Conclusion

Salmonella remains a serious challenge to human health. Good biosecurity on-farm is essential to help reduce the risk:

- ▶ Biosecurity must be in place continuously and respected at all times
- ▶ The right feed additives are part of good biosecurity management plans
- ▶ Top Gut® and Top Gut® WSP support high-performing animals during production, whilst mitigating *Salmonella* in the process

Top Gut®
The unique probiotic



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