ADDCON

TECHNICAL INFORMATION

Sustainable bacteria inhibition

Use of FORMI NDF in broiler to control Salmonella

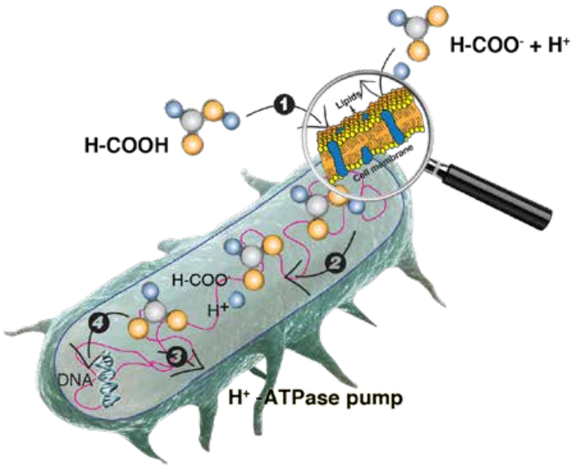
Christian Lückstädt

ADDCON
Bitterfeld, Germany
christian.lueckstaedt@addcon.com

Salmonella ranks among the world's biggest threats to health. The US-Center for Disease Control (CDC) estimates Salmonella bacteria cause about 1.35 million infections, 26,500 hospitalizations and 420 deaths in the United States every year (CDC, 2021). And these are just the reported cases. Salmonella ranks second on the food poisoning leader-board in the US where it's the premier bacterial food-borne disease (CDC, 2011). It is certainly serious enough to merit significant attention from the WHO and the CDC. Developing and implementing effective Salmonella monitoring, reporting and control systems has been prioritised in many countries. Salmonella is often associated with poultry products – chicken and eggs, but it would be a mistake to assume that these are the only food sources that can transmit the disease. Birds are a major source, true; strains can also be transmitted through pork and processed pork products, but it's also been spread through salad vegetables and peanuts. If we can eat it, there's a good chance that the bacteria can live on it, or at least survive long enough to be carried into an animal (or person)'s digestive tract. Although their native habitat is the intestinal tract of humans and animals, Salmonella are widely distributed in nature (Winfield and Groisman, 2003) – and as just mentioned, they are able to survive for an extended period of time on diverse materials – Salmonella can be considered ubiquitous (Humphrey, 2004). Since its discovery in the late 19th Century, more than 2,500 different types (serovars) have been discovered. All of these can cause disease in humans, which is most associated with acute gastroenteritis – fever, abdominal pain, diarrhoea and nausea, sometimes with vomiting. More often than not, this clears up within a week of infection without treatment. However, if the pathogen enters the bloodstream or the disease leads to dehydration, effective antibiotic treatment can be a lifesaver. Children and the elderly are particularly vulnerable, as are people with weakened immune systems. The health statistics also make for some sobering economic facts. In the US, for instance, the CDC recently estimated a total annual cost of US$3 billion associated with Salmonella. Like other foodborne bugs, Salmonella is developing resistance to the drugs we use to treat it. Much of the blame has fallen with animal production. Preventing or treating diarrhoeal diseases in livestock has played a major part in the development of multi-drug resistant strains. The two most commonly seen serovars in human salmonellosis epidemics (Garber et al., 2003), *Salmonella enteritidis* and *S. typhimurium* have emerged over the past 30 years in parallel with intensive animal husbandry. Now, we find bacteria, including these two, with worryingly high levels of resistance against the antibiotics we use to treat them. Antibiotic resistance in Salmonella has two major consequences that cause the medical profession so much concern. Firstly, patients taking an antibiotic for unrelated infections, for example a chest infection, are more risk of contracting antibiotic-resistant Salmonella infections. Secondly, treatment for salmonella fails more frequently, causing prolonged or more severe illness, increased

hospitalisations and more deaths. A recent US review estimated that antimicrobial resistance in Salmonella may result in 30,000 more infections each year, leading to 300 more hospitalisations and 10 deaths. Salmonella is a big risk to the world's economies. The European Union, one of the regions in the world with the most stringent Salmonella surveillance and control systems, collected data from 21 Member States and reported that: 'The proportion of Salmonella and E. coli isolates resistant to ampicillin, sulfonamides and tetracycline varied between 5 and 68 % in poultry, pigs and cattle. Some Member States reported a high occurrence of fluoroquinolone resistance in Salmonella isolates from poultry (5-38%)' (EFSA, 2010).

But the risks of pathogenic bacteria can be reduced, also without the prophylactic dosage of antibiotics. All along the food chain, experts have identified points at which intervention can help reduce the risk of Salmonella infections. While Salmonella cannot be eradicated in pig units, it can be controlled to minimise the risk to consumers. According to Jones (2011) Salmonella control principle in feed can be divided into three major categories: efforts to prevent contamination of the facility, measures to reduce multiplication of the bacteria in the plant and procedures to kill the pathogen. Biosecurity plays a significant role in Salmonella control. In feed compounding, although heat treatment is effective in reducing contamination of feed leaving the feed mill, this effect does not persist during transport, storage and subsequent outfeeding. When conditions within the feed are less conducive to bacterial infection, Salmonella contamination can be reduced. The next critical control point is within the poultry's gut itself, where conditions for bacterial growth may once again be optimal. Salmonella growth requires warmth (35-37°C is optimal), a moisture content greater than 12% and a pH between 4.5-9.0. It is no coincidence that the intestine of poultry can provide Salmonella everything it needs to thrive. Therefore, Jones (2011) suggests chemical additions to control Salmonella via the feed – and this may primarily involve the use of organic acids.



Antibacterial action of organic acids, including Formi NDF, against Salmonella.

However, liquid and volatile acids exert their antibacterial effects only in the feed and the birds' foregut. More recently, research has focused on overcoming these limitations to develop chemical compounds which are heat-stable, non-corrosive and yet still effective. Sodium diformate (Formi NDF), developed and marketed by ADDCON, satisfies such industry requirements. It has been a proven track-record of being effective in the animal. In order to validate the impact of Formi NDF against Salmonella in broiler, a study in the Ukraine was carried out.

The objective of the trial was to evaluate the effect of Formi NDF in broilers in vivo, on the control of bacterial (*Salmonella typhimurium*) contamination in the digestive tract, several organs, as well as the faeces, in comparison to a negative control. The trial was carried out at the Animal Agriculture Institute of the National Academy of Agricultural Sciences of the Ukraine in Kiev. 108 birds (Cobb 500) were distributed equally into 2 groups (control and treatment). Broiler were housed in cages, to avoid cross contamination between birds. The birds were fed crumbled feed, according to Cobb recommendations, over a trial period of 42 days. From day one onwards, the feed was challenged with *Salmonella typhimurium* (strain No: 371) at 10^9 CFU per ml. The treated birds received the control diet plus an addition of 0.3% NDF. The Salmonella infection was monitored qualitatively (positive or negative) at the end of the trials in broiler organs (intestine, heart, lung, spleen) and faeces.

Results achieved show a clear picture. The complete colonization of the unprotected negative control broiler took approximately three weeks – in which all organs were affected, while the excreted faeces were impacted already after only one week – thus would be responsible under commercial conditions even for a further spread of the bacterial contamination. Survival rates in both groups remained high at 98%.

	Age of birds											
	1 week		2 weeks		3 weeks		4 weeks		5 weeks		6 weeks	
	NC	NDF	NC	NDF	NC	NDF	NC	NDF	NC	NDF	NC	NDF
Heart	-	-	-	-	+	-	+	-	+	-	+	-
Lungs	-	-	-	-	+	-	+	-	+	-	+	-
Spleen	-	-	+	-	+	-	+	-	+	-	+	-
Intestine	-	-	+	+	+	-	+	-	+	-	+	-
Faeces	+	-	+	+/-	+	+/-	+	-	+	-	+	-

NDF-fed broiler on the other hand, had only a mild infection with Salmonella in the faeces over a period of about three weeks – after that, the additive was able to protect the birds from the bacterial contamination. This is in full agreement with published results and world-wide commercial experience in broiler, layer or parent stock. The usage of 3 kg/t of FORMI NDF was able to inhibit Salmonella infections and offers therefore a way to sustainable poultry production without the usage of antibiotics.

Conclusions

Numerous reports have demonstrated that including sodium diformate (FORMI NDF) in broiler diets has beneficial effects on lowering bacterial pathogen load, including Salmonella. Using acidification in broiler diets is therefore a valuable strategy in a salmonella control programme.

contact@addcon.com

proud member of ESSECO GROUP

ADDCON GmbH
Parsevalstraße 6,
06749 Bitterfeld-Wolfen,
Germany
Phone: +49 3493 96787 00
Fax: +49 3493 96787 70
www.addcon.com

ADDCON EUROPE GmbH
Areal E / Säurestraße 1,
06749 Bitterfeld-Wolfen,
Germany
Phone: +49 3493 96787 00
Fax: +49 3493 96787 70
www.addcon.com

ADDCON NORDIC A/S
Postboks 1138 Herøya
3905 Porsgrunn
Norway
Phone: +47 35 56 41 00
Fax: +47 35 56 41 01
www.addcon.com

ADDCON Asia Ltd.
Workshop 2, 12/F,
Winning Centre
29 Tai Yau Street, San Po Kong
Kowloon, Hong Kong
Phone: +852 2368 0091
Fax: +852 2368 0127
www.addcon.com

ADDCON (Dalian) Environmental Products Ltd.
Room 4403,Tower A,Times Square,
No. 50 Renmin Road,
Zhongshan District,
Dalian 116001, China
Phone: +86 411 82538001
Fax: +86 411 82538010
www.addcon.com