

---

# Evaluation of the prophylactic and therapeutic effect of a phage cocktail to control *Salmonella* Enteritidis in poultry

Lorna Agape<sup>\*1</sup>, Pierrette Menanteau<sup>1</sup>, David Gauthier<sup>2</sup>, Noémie Perrot<sup>2</sup>, Alain Deslis<sup>2</sup>, Mickael Riou<sup>2</sup>, Catherine Schouler<sup>1</sup>, and Philippe Velge<sup>1</sup>

<sup>1</sup>INRAE – ISP, INRA, Université de Tours, UMR 1282, Nouzilly, France – France

<sup>2</sup>INRAE – UE-1277 Plateforme d’Infectiologie Expérimentale (PFIE), 37380, Nouzilly, France – France

## Résumé

*Salmonella* is one of the main causes of foodborne diseases related to poultry product consumption and is a public health concern. The use of lytic bacteriophages could be a novel, safe and effective approach, to reduce the prevalence of *Salmonella* in poultry and subsequently reduce the incidence of foodborne salmonellosis in humans.

This study evaluates the prophylactic and therapeutic effect of phages, administered via drinking water, on *Salmonella* levels in chickens. A cocktail of 6 lytic phages with demonstrated *in vitro* efficacy against various *Salmonella* serotypes was used.

First, the phages were demonstrated to persist in chickens’ gut for at least 3 days without *Salmonella* challenge. The prophylactic potential of the cocktail was then evaluated *in vivo*. Fifty chicks were challenged by oral gavage with *Salmonella* Enteritidis LA5 at 5x10<sup>4</sup> CFU/chick at 7 days of age. Phages were administered before the challenge via drinking water during the first 6 days of the chicks’ life and 2 days prior to the end of the trial to check emerging resistance. The ability of resistant clones to colonize chicks was also studied. The therapeutic potential of the cocktail was also evaluated by giving phages at the end of the trial to decrease carcass contamination at slaughter. During the different trials, *Salmonella* enumeration and phage identification and counting were investigated.

Results showed that up to 4 days post infection, phages had a preventive effect and they significantly ( $P < 0.05$ ) reduced *Salmonella* colonization in ceca and feces by 2 to 4 logs. *Salmonella* levels increased 7 days post infection, after phage treatment was stopped. During this period, only 2 out of 6 phages were detected in the different gut segments. *Salmonella* resistance was observed only against these persistent phages and resistant clones recovered shown a reduced colonization capacity in chickens’ gut. No resistance was observed against the other phages. Indeed, resumption of phage administration 2 days before the end of the trial reduced the *Salmonella* loads again by 1 log in the ceca. In parallel, the therapeutic use of phages reduced *Salmonella* cecal level by 4 logs compared to the situation before phage administration.

This treatment showed encouraging results regarding the effect of phages on *Salmonella* levels in chickens during critical steps of poultry production. Future work will be to study the mechanisms of resistance acquired by *Salmonella in vivo* and also the impact of this treatment on the chicken’s microbiota.

---

\*Intervenant

**Mots-Clés:** Salmonella, Poultry, phage therapy