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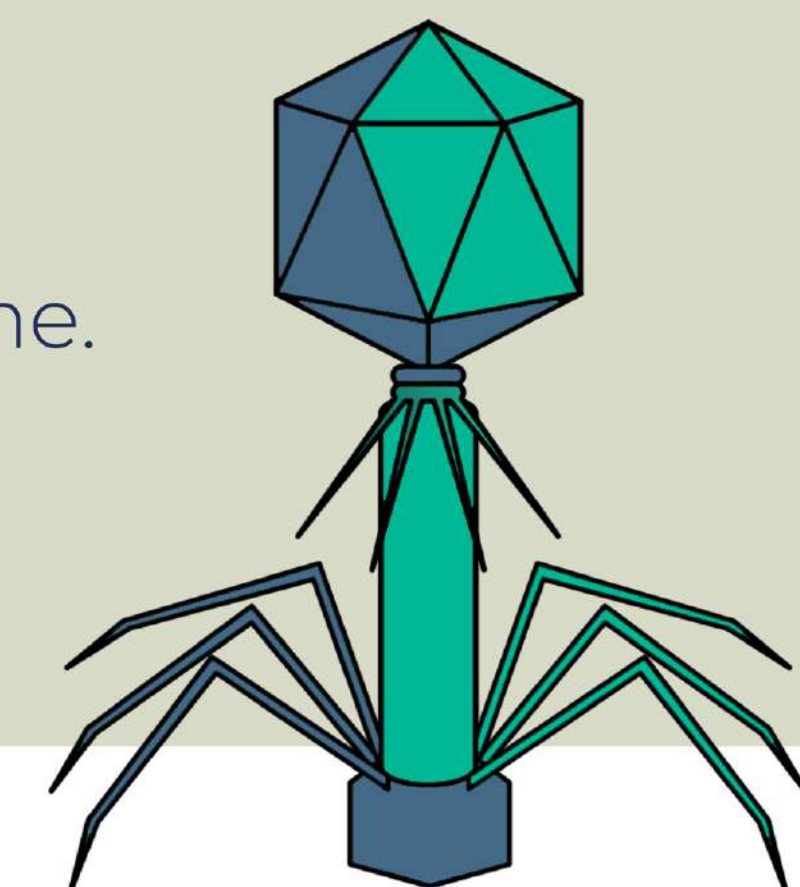


# Bacteriophage cocktail for the targeted inhibition of *Salmonella enterica* in broiler chickens

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## Abstract

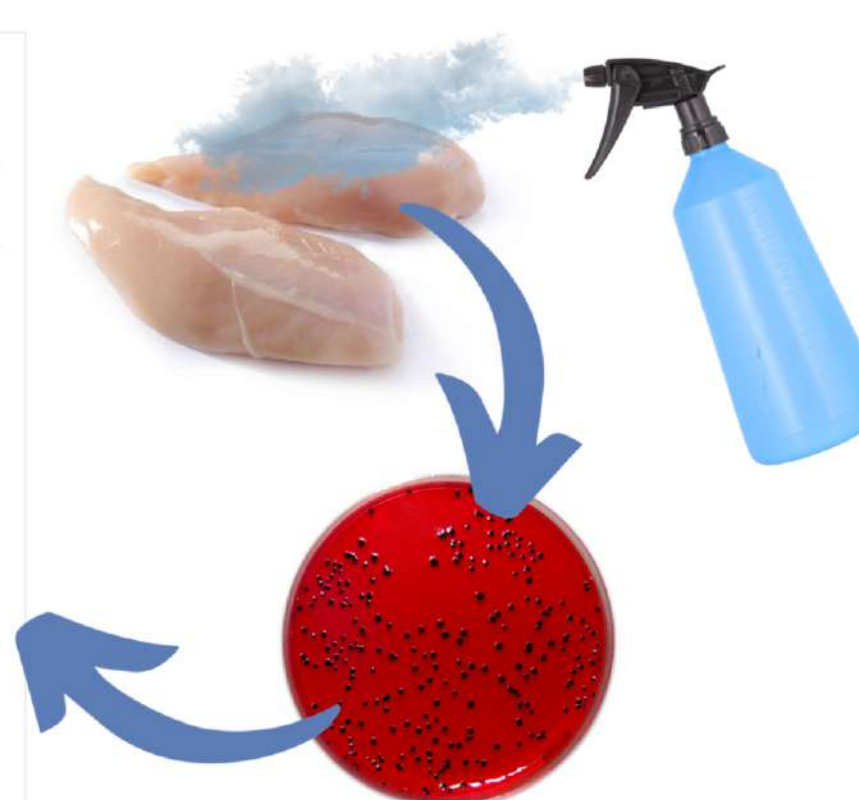
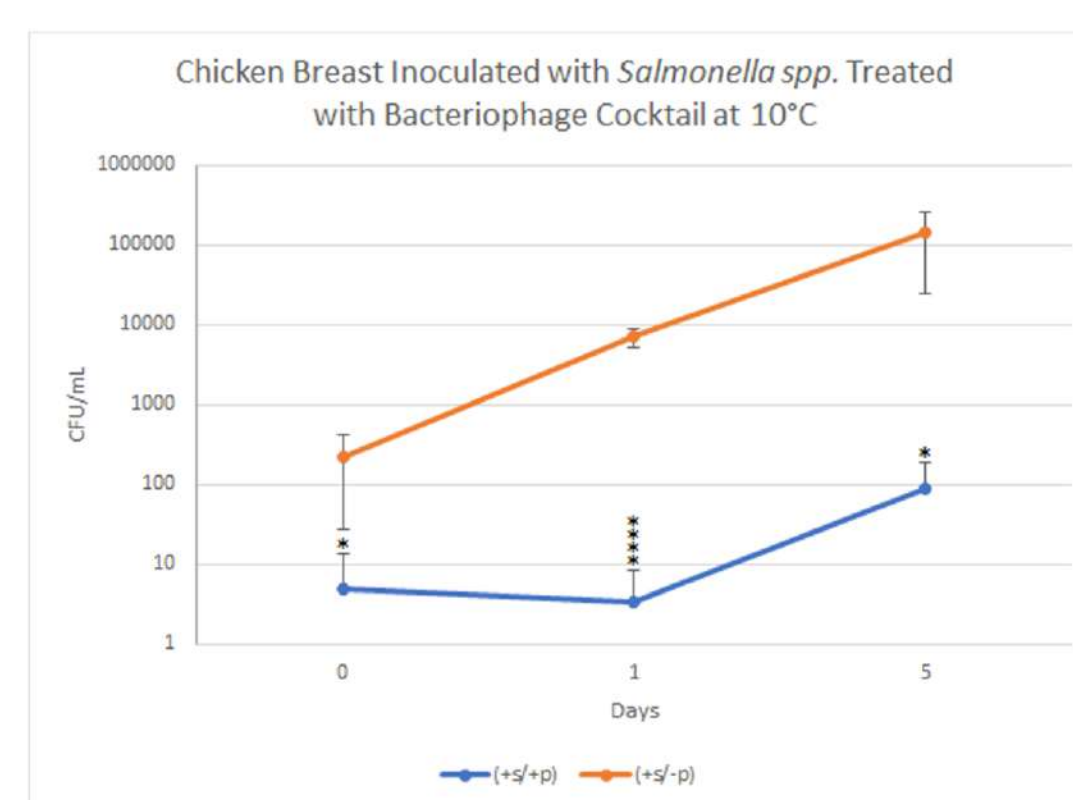
- Investigating environmental bacteriophages (phages) for application against *Salmonella spp.* in poultry.
- Phages target specific bacteria of interest and do not impact food quality, nutrition, or animal microbiome.
- Strong bactericidal activity observed for a free phage cocktail sprayed directly onto chicken breast.
- When encapsulated, the phage cocktail was also effective when ingested by mature broiler chickens.



## Introduction

We cannot sterilize our food with harsh chemical or physical treatments due to the impacts on safety and sensory qualities. Phages have a lot to offer as food-safe antimicrobials because they are safe to eat, clean label, cost competitive, and they do not affect food aroma, flavor, or nutrition. We have developed a phage cocktail to target prominent *Salmonella* serovars on chicken meat and when ingested by broiler chickens.

## Phage Spray on Chicken Breast



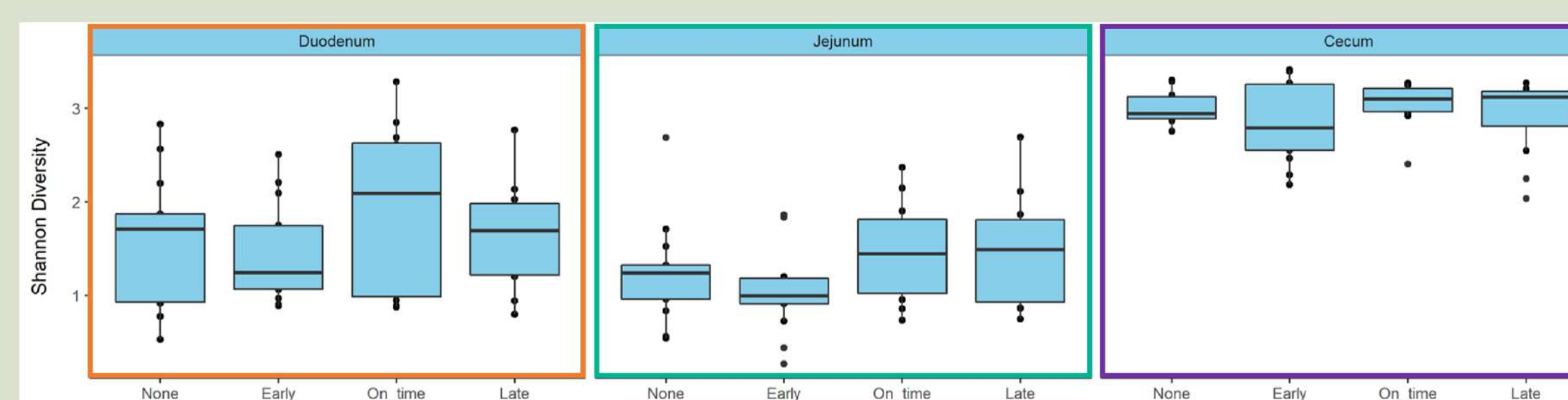
~3.21 log reduction in *Salmonella*, compared to control, when phage cocktail was sprayed onto challenged chicken breast. Viable *Salmonella* was enumerated on XLD agar.

## Encapsulated Phage Ingested by Broilers



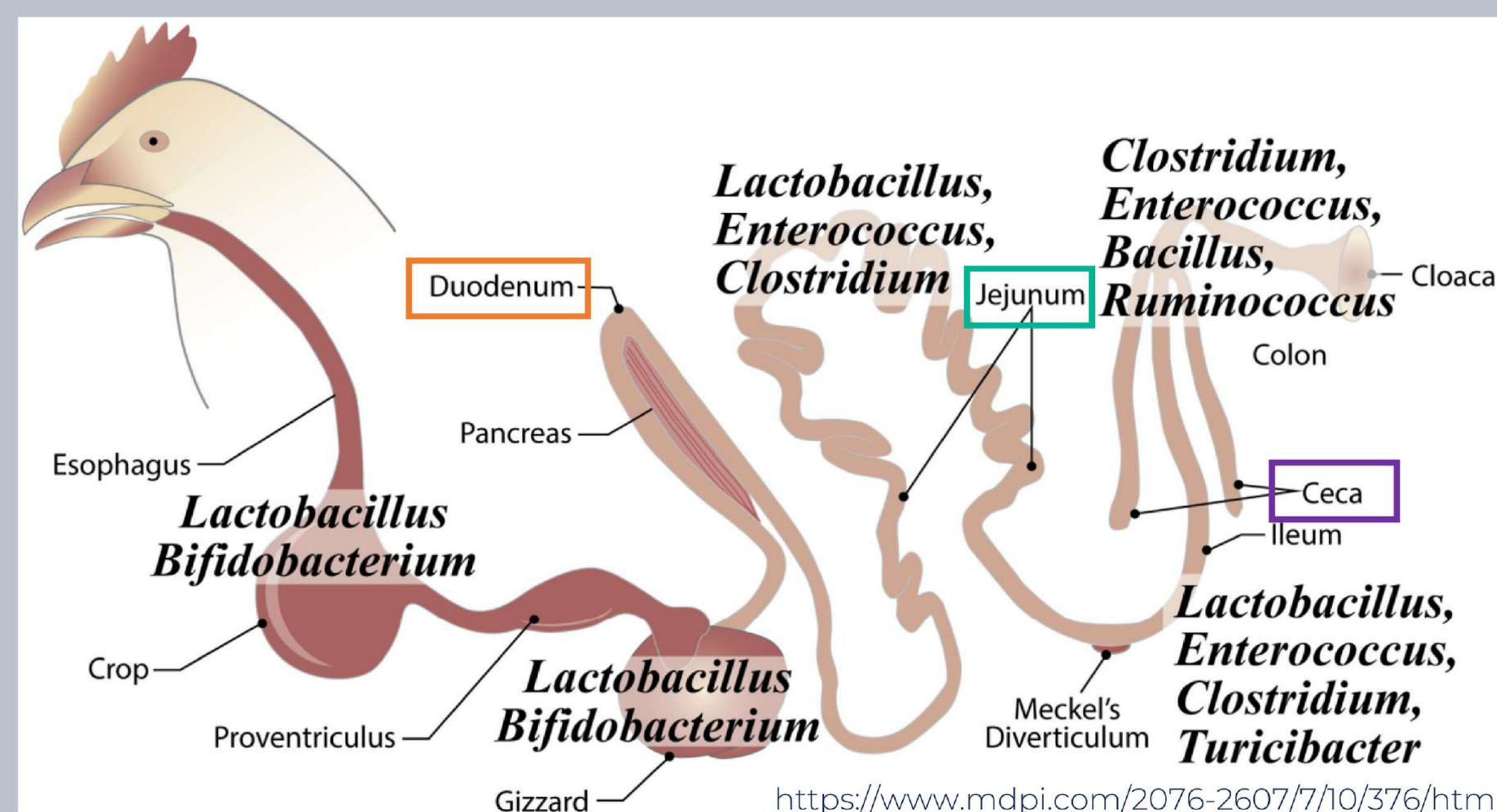
~1.72 log reduction in *Salmonella*, for 'on-time' treatment compared to control group, when encapsulated phage cocktail was ingested by mature broiler chickens. Viable *Salmonella* was enumerated from cloacal swabs on XLD agar.

## Broiler Microbiome: Alpha Diversity



Species diversity did not differ significantly across treatment groups for sites tested.

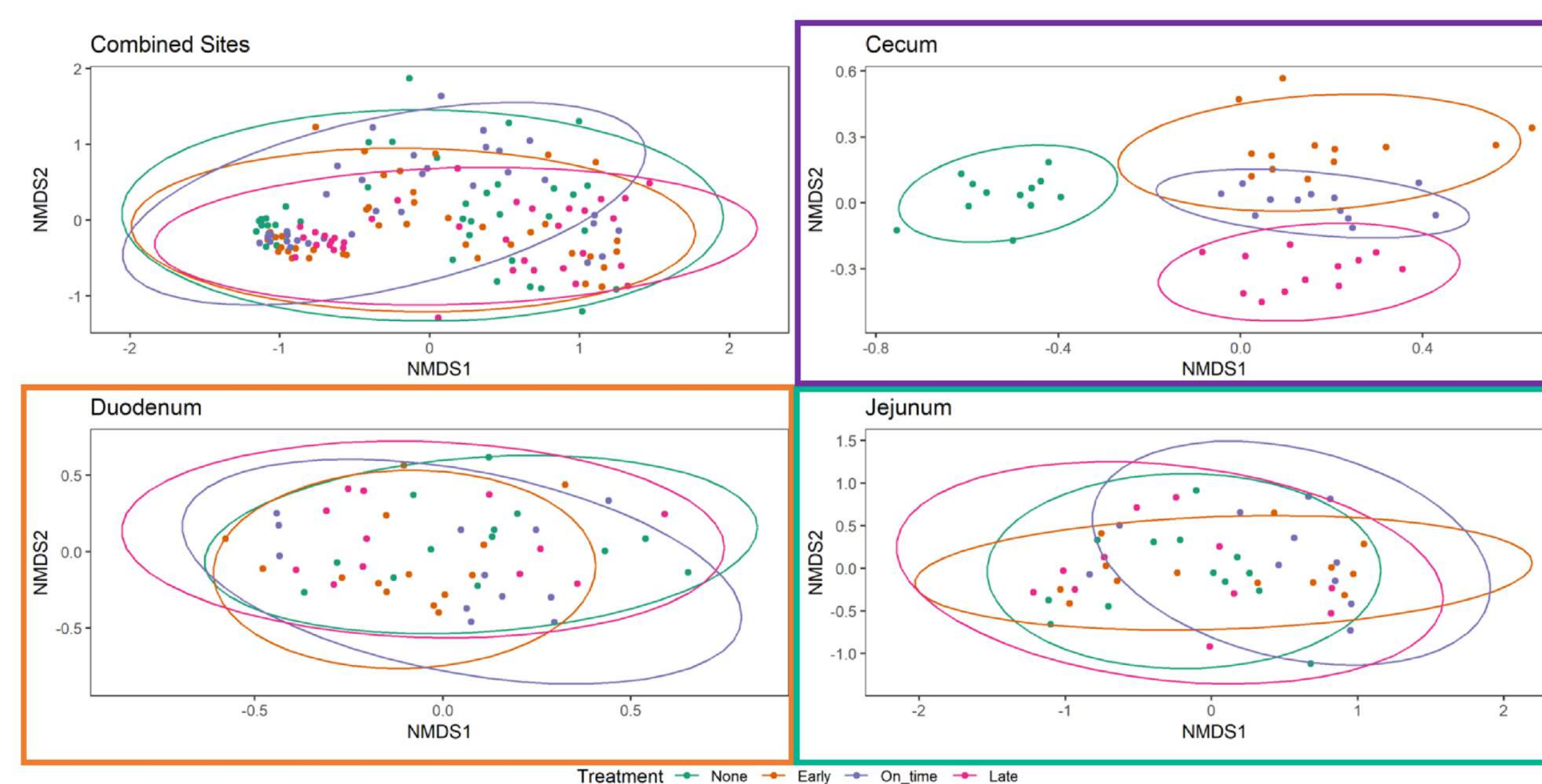
## Broiler Microbiome: Sample Collection



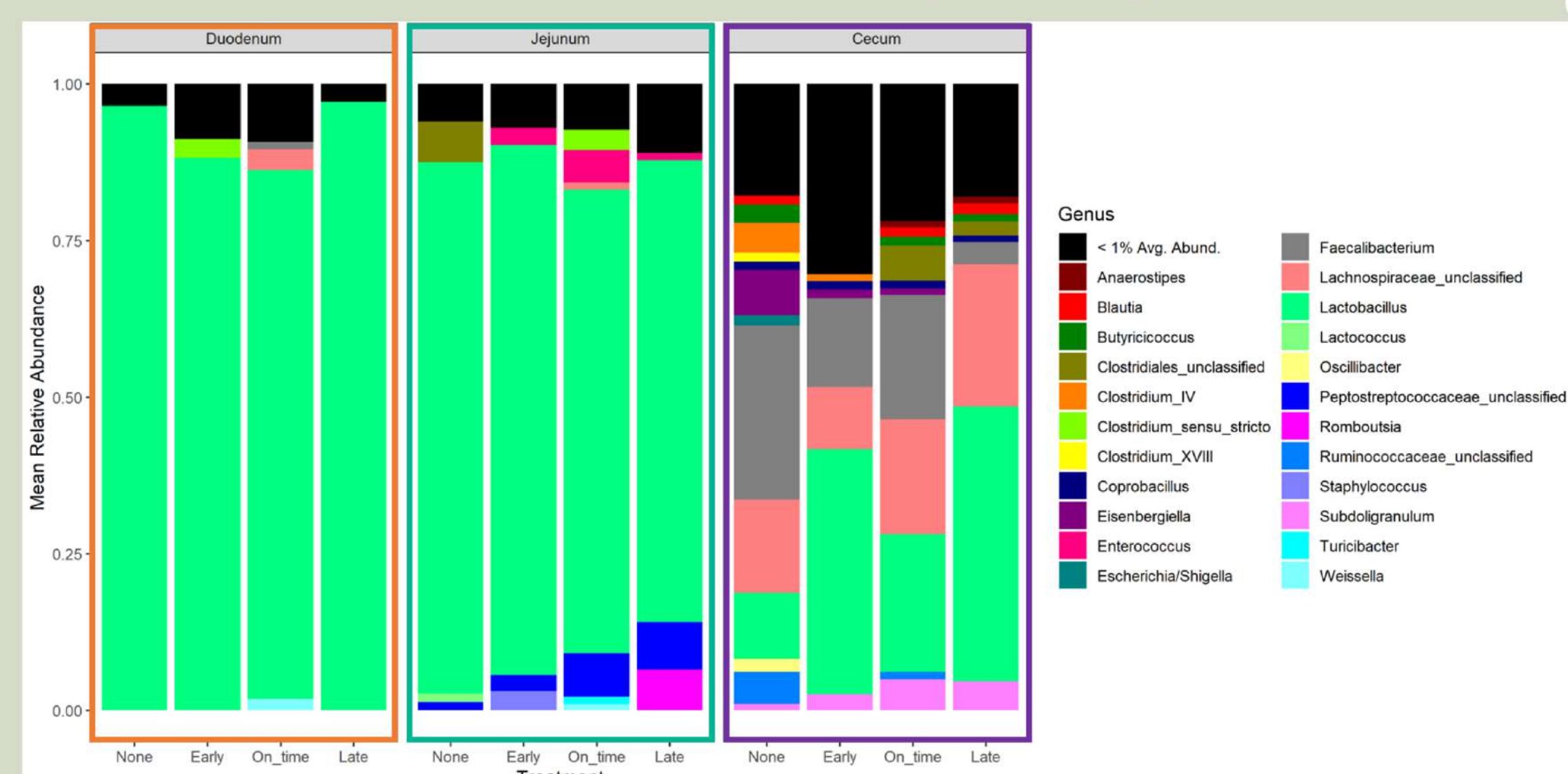
Digesta samples were collected from the duodenum, jejunum, and cecum of all birds to represent the upper, middle, and lower digestive system microbiomes, respectively. DNA was extracted from all samples and sent for 16S rRNA sequencing.

## Broiler Microbiome: Beta Diversity

No significant differences between bird microbiomes observed for duodenum and jejunum samples between treatment groups. However, it appears that the untreated cecum samples differ from all phage treatment groups. This indicates that phage are reaching the cecum and having a targeted effect.



## Microbiome: Taxonomy Barplots

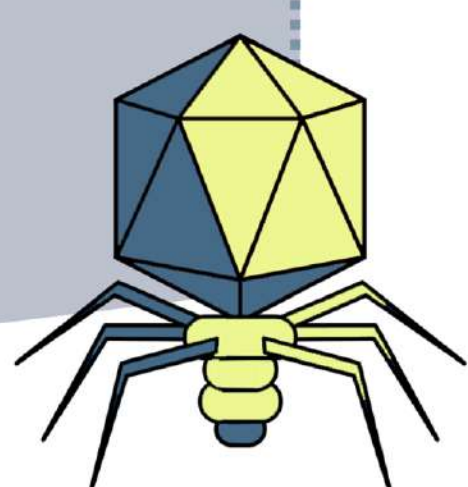


Again, negligible changes are observable between microbiome composition for duodenum and jejunum samples between treatment groups. However, it is interesting that *Escherichia* and *Shigella*, which are closely related to *Salmonella*, are only apparent in the untreated cecum group. This may be an indication of slight off-target killing. Additionally, growth rates did not differ significantly, and bird health was equivalent, between all treatment groups.

## Conclusions

There has been a gap in research regarding phage treatment delivery to the lower gastrointestinal tract of mature broiler chickens. Unprotected phage cocktails have shown limited effectiveness in mature broilers, but our method appears to be both safe and effective for reducing prominent *Salmonella*.

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