# Black Soldier Fly (*Hermetia Illucens*) Larvae Meal - Mediated Chicken Gut Microbiota Alteration Restricts Chicken Coronavirus Infection


SIAT

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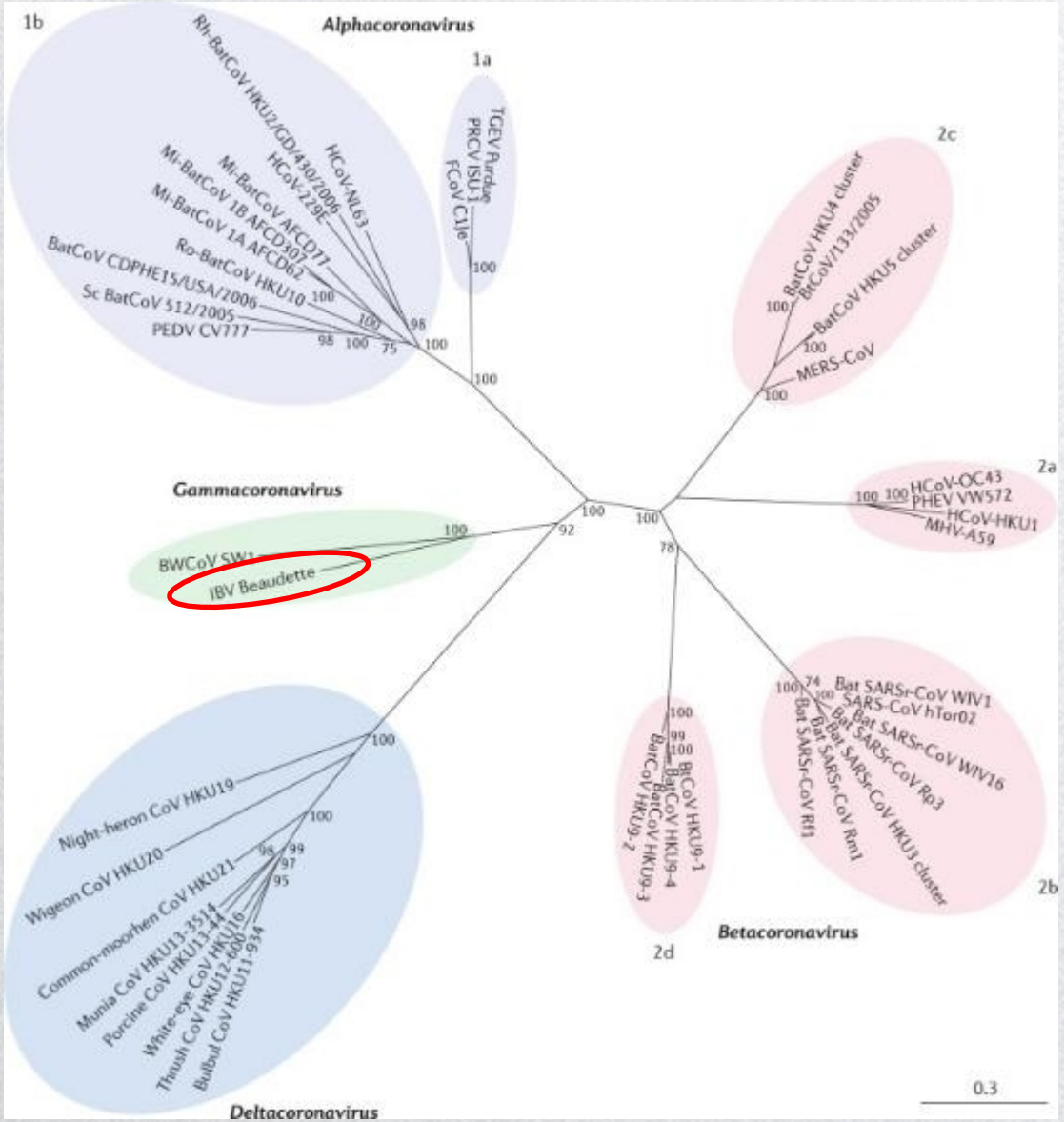
2023.08.28

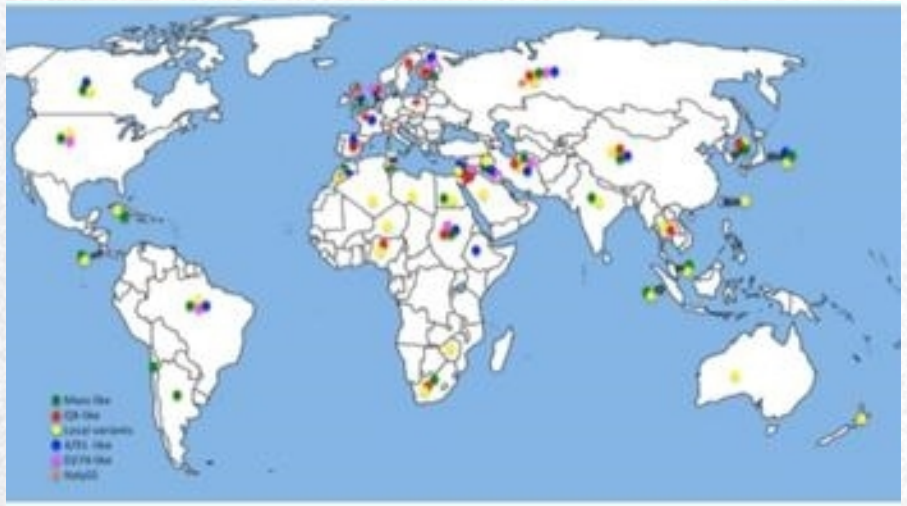
# Avian infectious bronchitis virus (IBV)

## IBV in coronavirus




Cui et al., 2020

## IBV distribution

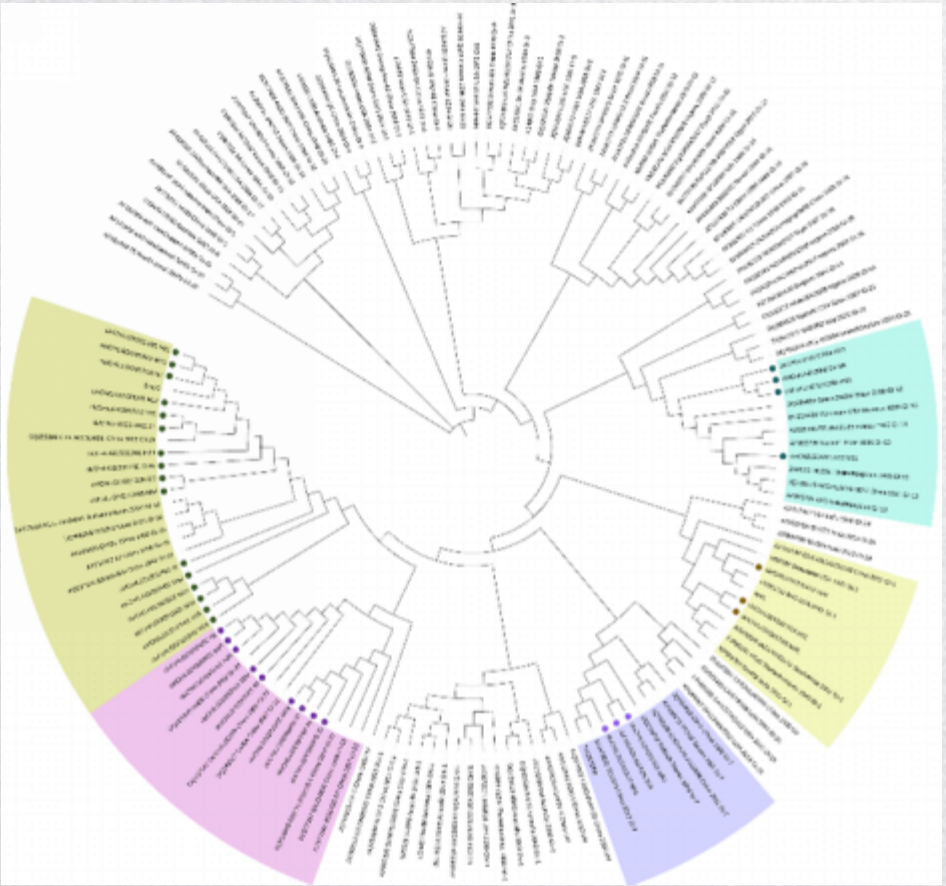


Bande et al., 2017

## Symptoms of IBV infection

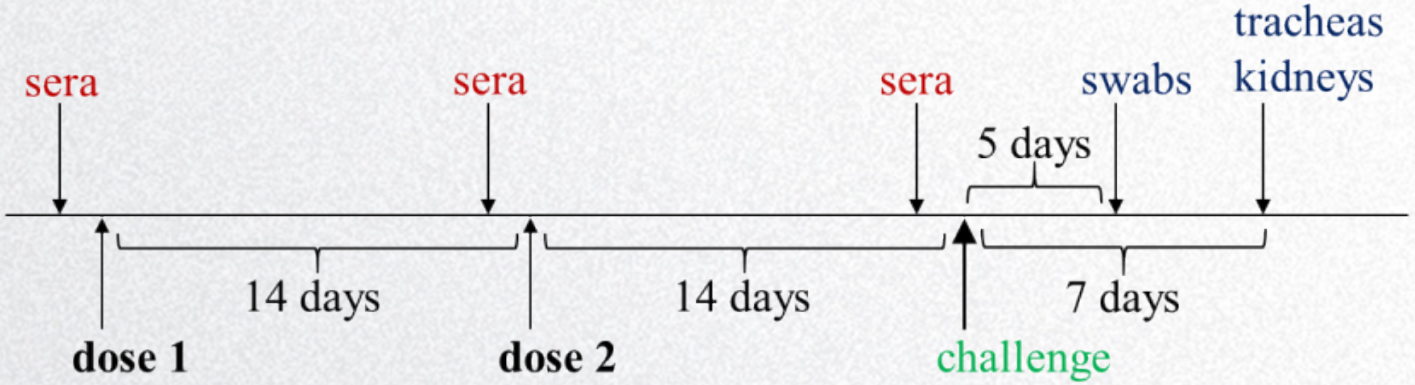
# Current approaches for controlling IBV

## IBV genotypes



- QX (GI-19) Dominant in China
- HN08 (GI-22)
- TW (GI-7)
- 4/91 (GI-13)
- Mass (GI-1)

## Vaccination




- High level of biosecurity
- Live-attenuated + inactivated vaccines
- Suitable combinations of live vaccines
- Mucosal immunity & cellular immunity

## Black soldier fly

## Advantages as animal feed

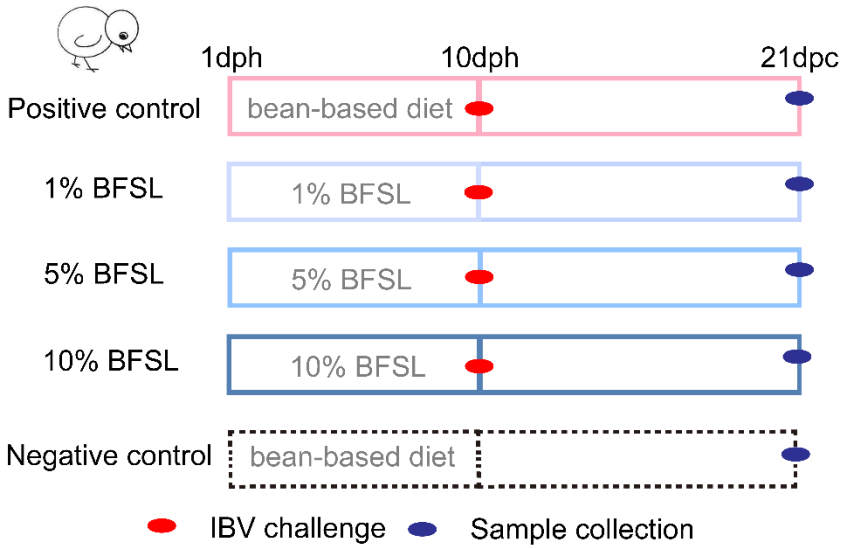
- Rich in protein, fat, and calcium
- Balanced composition of amino acids
- Rich in lauric acid
- Effective usage of the nutrients by animals

## Black soldier fly larval diet in chickens

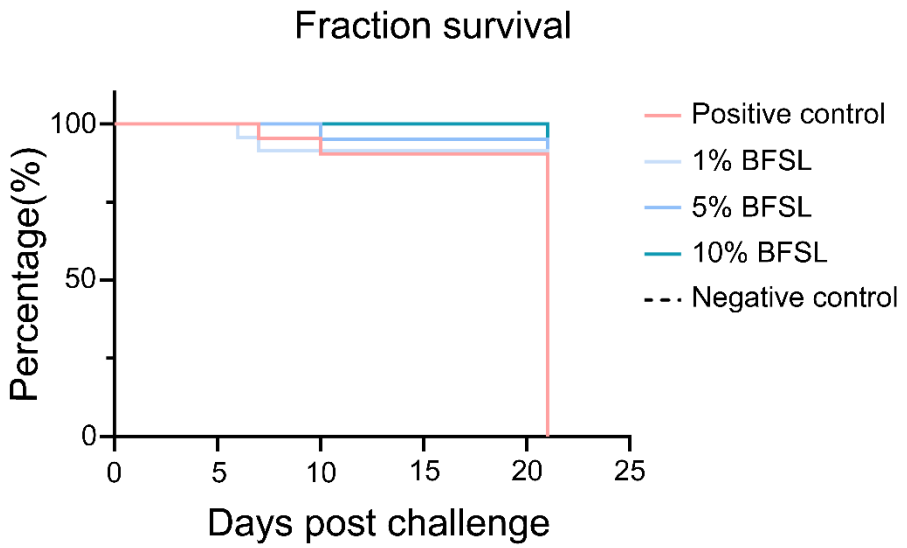
| Amount | Effect | Reference |
|---|---|---|
| 0-15% | Enhance immunity | Lee et al., 2018 |
| 17% | Improve chitin-degrading gut microbiota in cecum<br>Improve content of short chain fatty acids | Borrelli et al., 2017<br>Cutrignelli et al., 2018 |
| 0-20% | No effect on growth performance | Schiavone et al., 2016<br>Altmann et al., 2018<br>Pieters et al., 2018 |

## BFSL diet decreased mortality and morbidity rates of IBV infected young SPF chickens

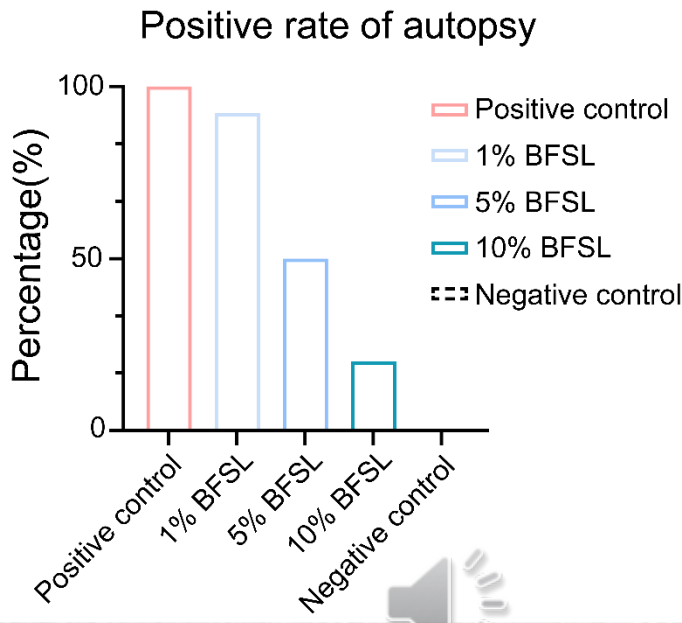
A




B

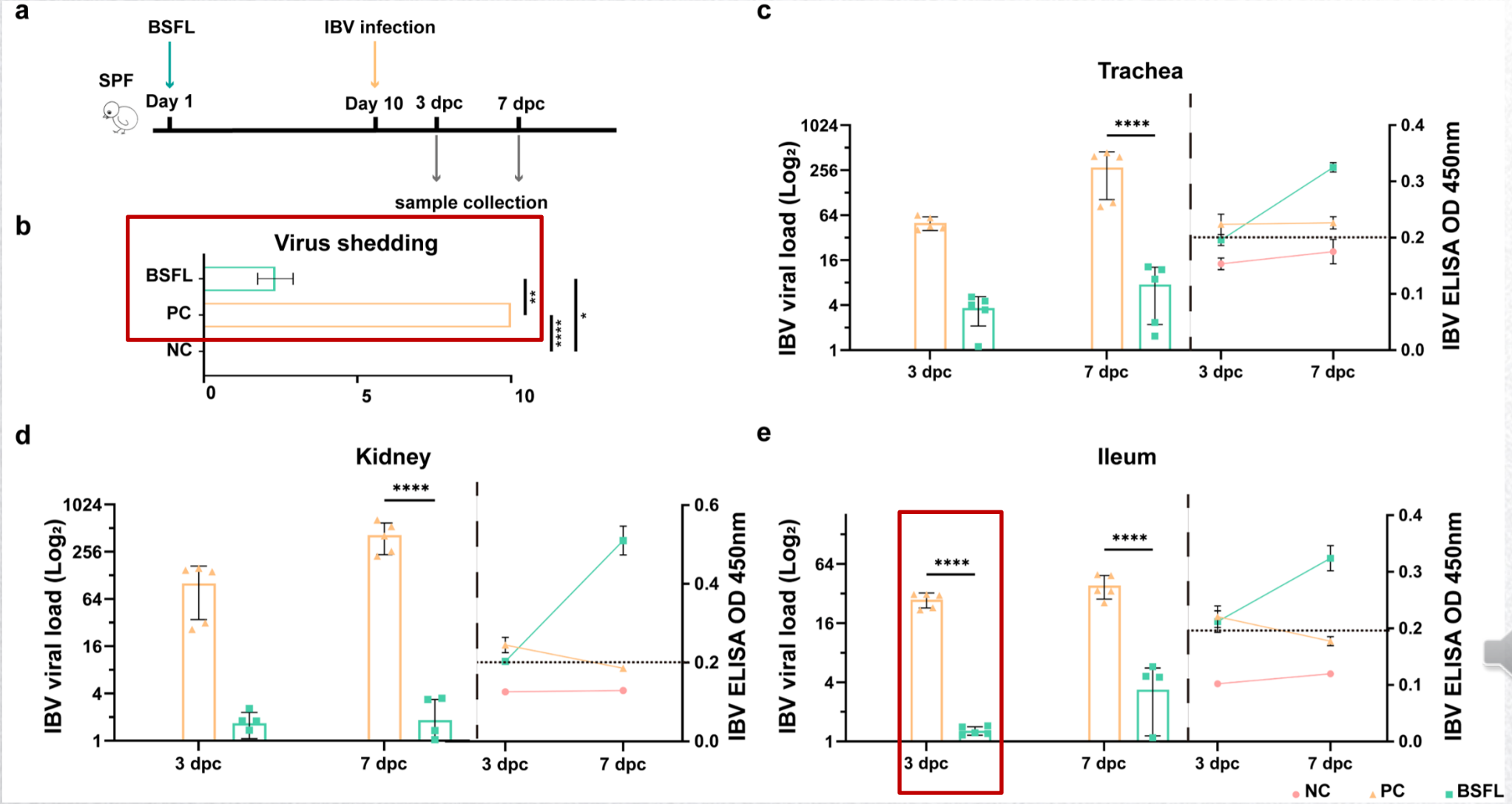



C

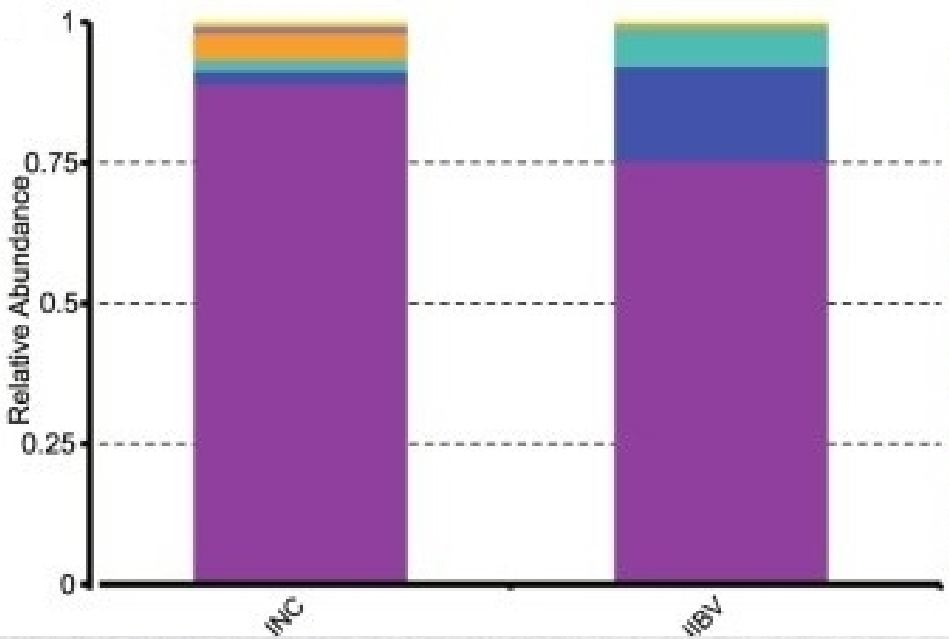



Zhang et al., 2021

# Supplement of 10% BFSL in diet decreased viral loads in SPF chickens



Question

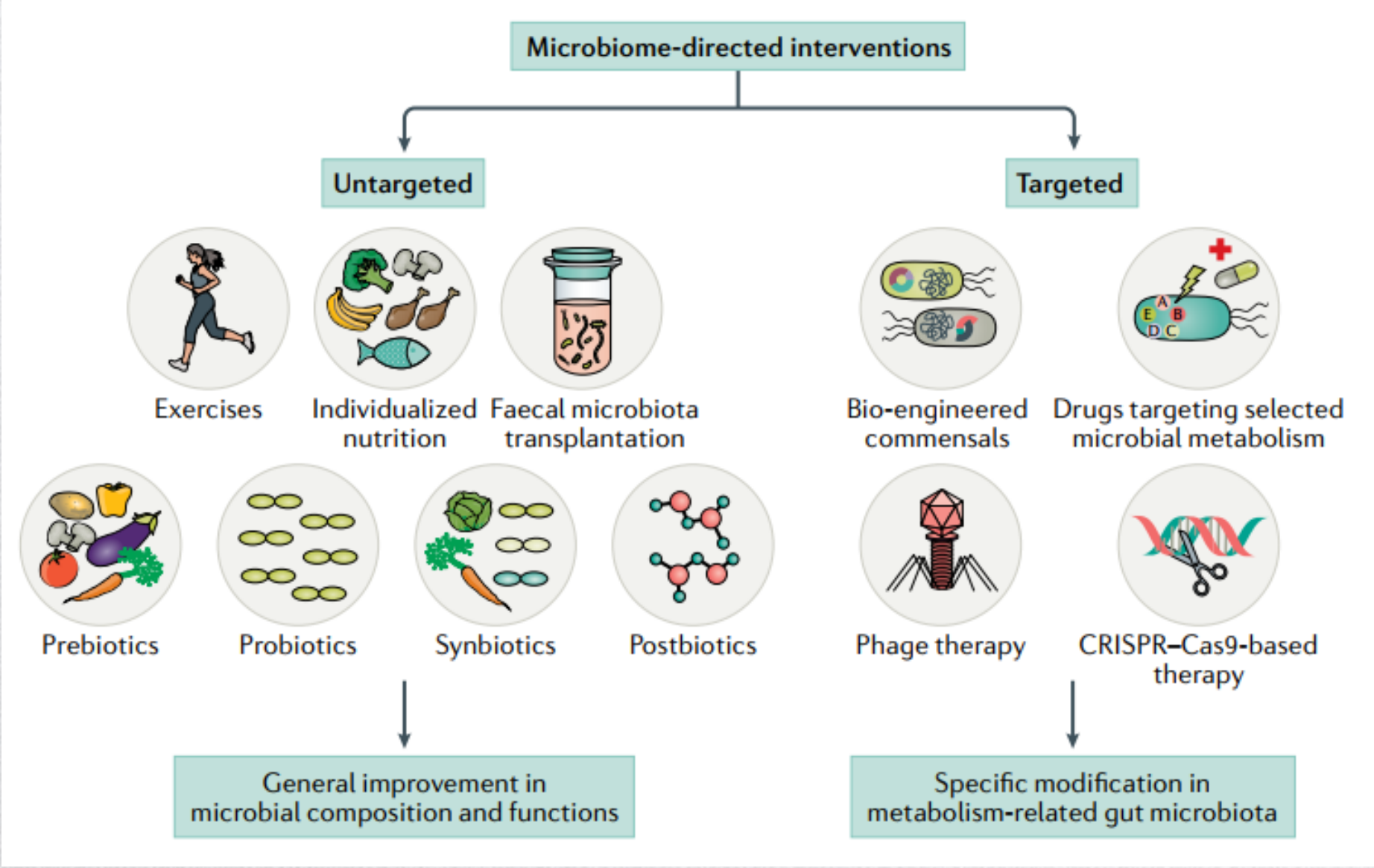



| Taxonomy | INC | IIBV | |
|---|---|---|---|
| *Others* | 0.39% | 0.30% | ↓ |
| *Thermomicrobia* | 0.03% | 0.01% | ↓ |
| *Tenericutes* | 0.07% | 0.05% | ↓ |
| *Fusobacteria* | 0.002% | 0.02% | ↑ |
| *Verrucomicrobia* | 0.08% | 0.004% | ↓ |
| *Saccharibacteria* | 0.07% | 0.01% | ↓ |
| *Actinobacteria* | 1.12% | 0.22% | ↓ |
| *Cyanobacteria* | 4.76% | 0.37% | ↓ |
| *Bacteroidetes* | 1.91% | 6.69% | ↑ |
| *Proteobacteria* | 2.36% | 16.89% | ↑ |
| *Firmicutes* | 89.21% | 75.44% | ↓ |

Xu et al., 2020

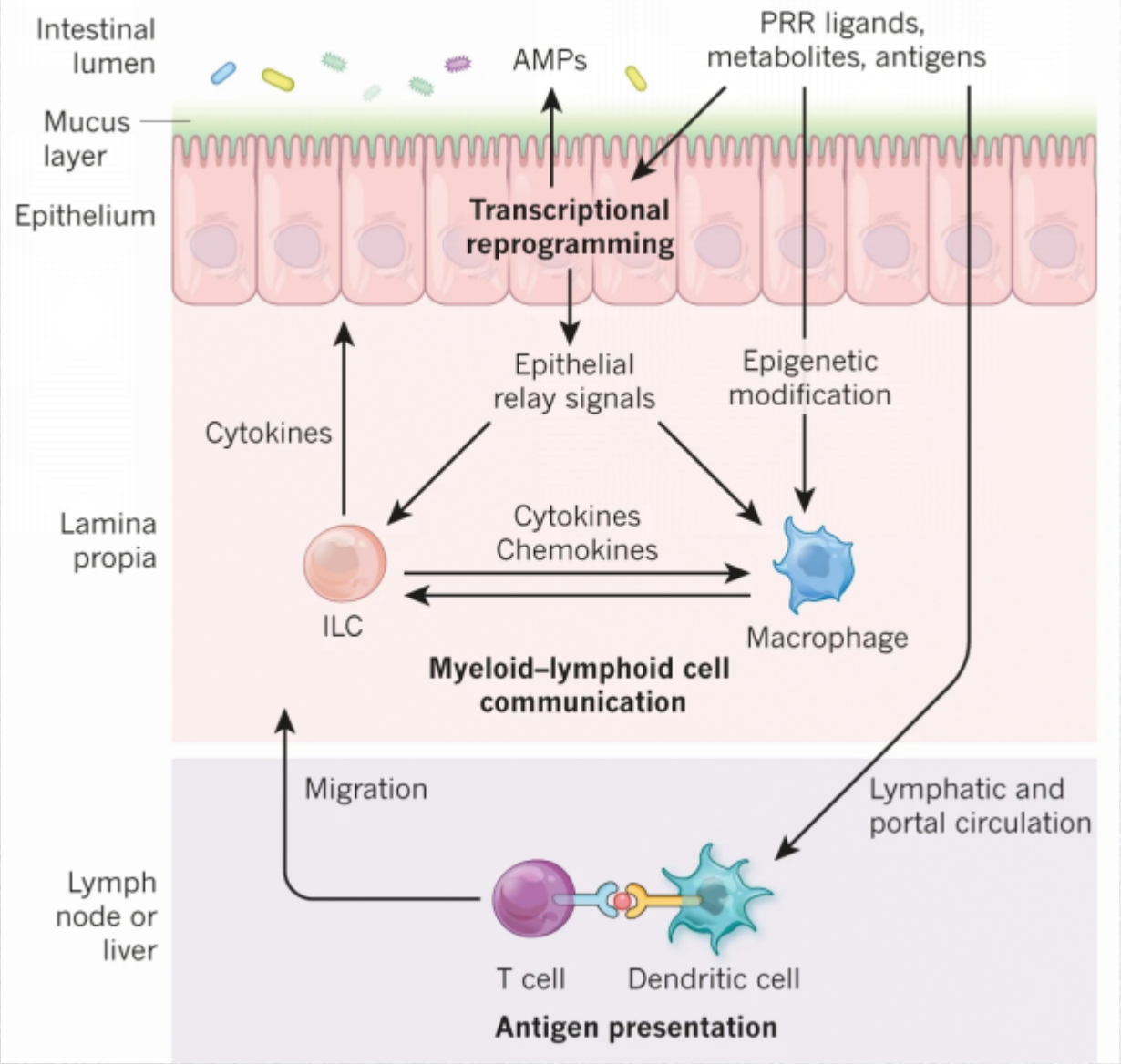
# BFSL alters Gut Microbiota to resist IBV ?

# Microbiome-directed interventions




Fan and Pedersen, 2020

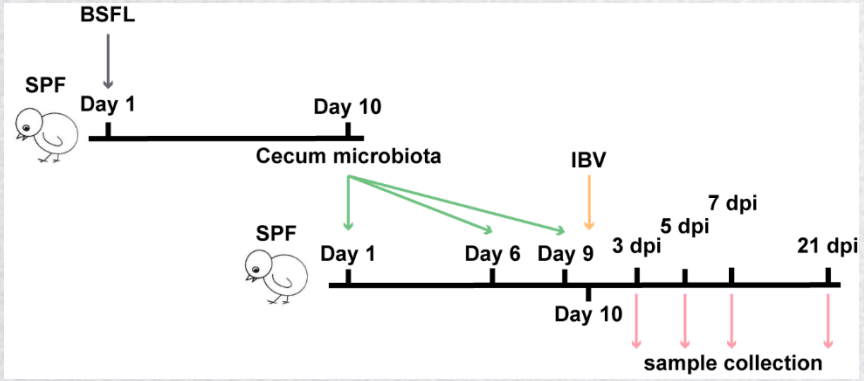
# Interaction of Gut Microbiota and Innate Immunity



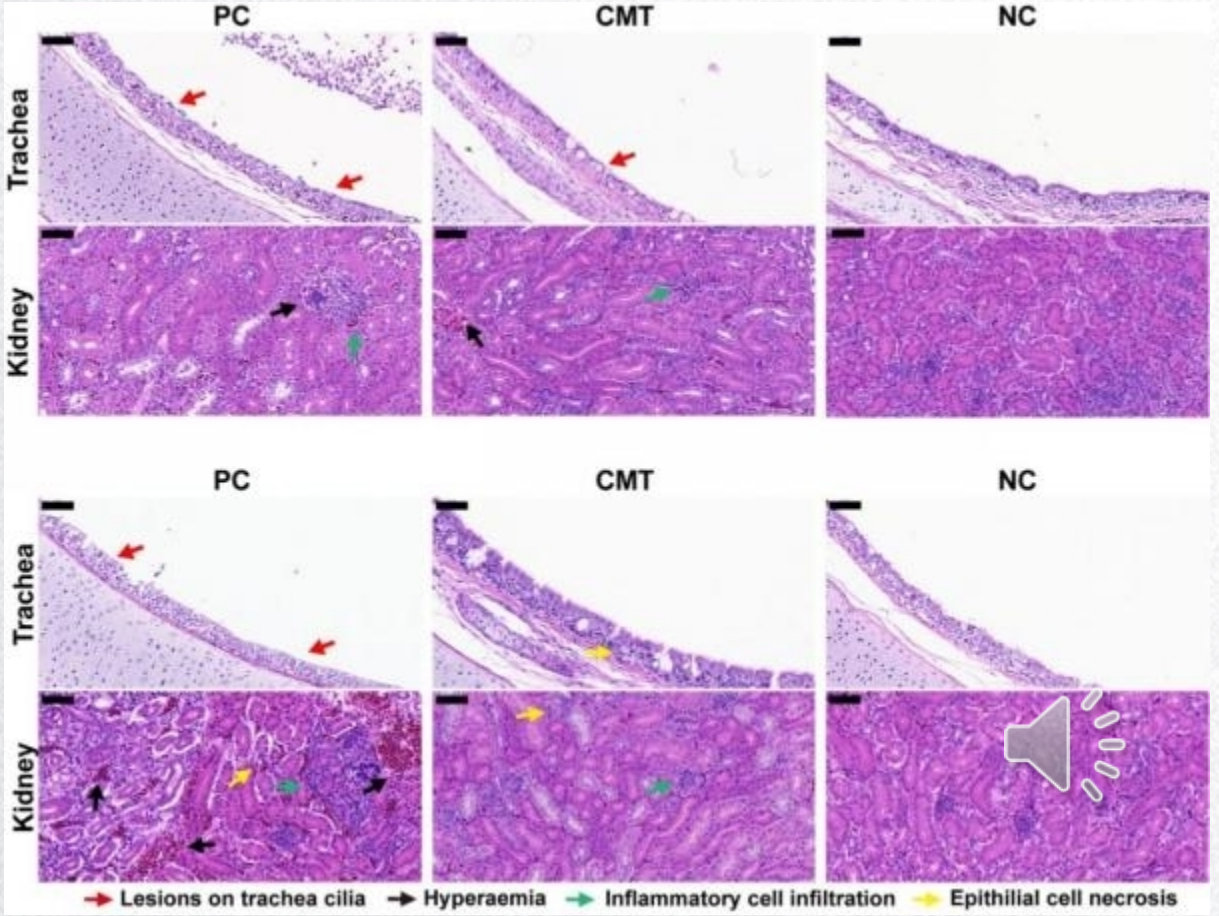

Thaiss et al., 2016

## Gut Microbiota Transplantation:

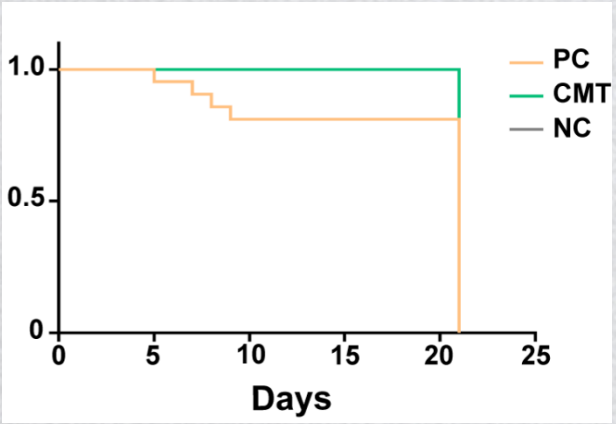
Reduce mortality and morbidity rate
Reduced viral loads
Relieve histopathological damage



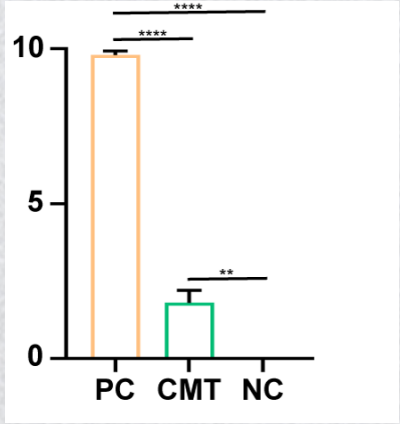

## Histopathology



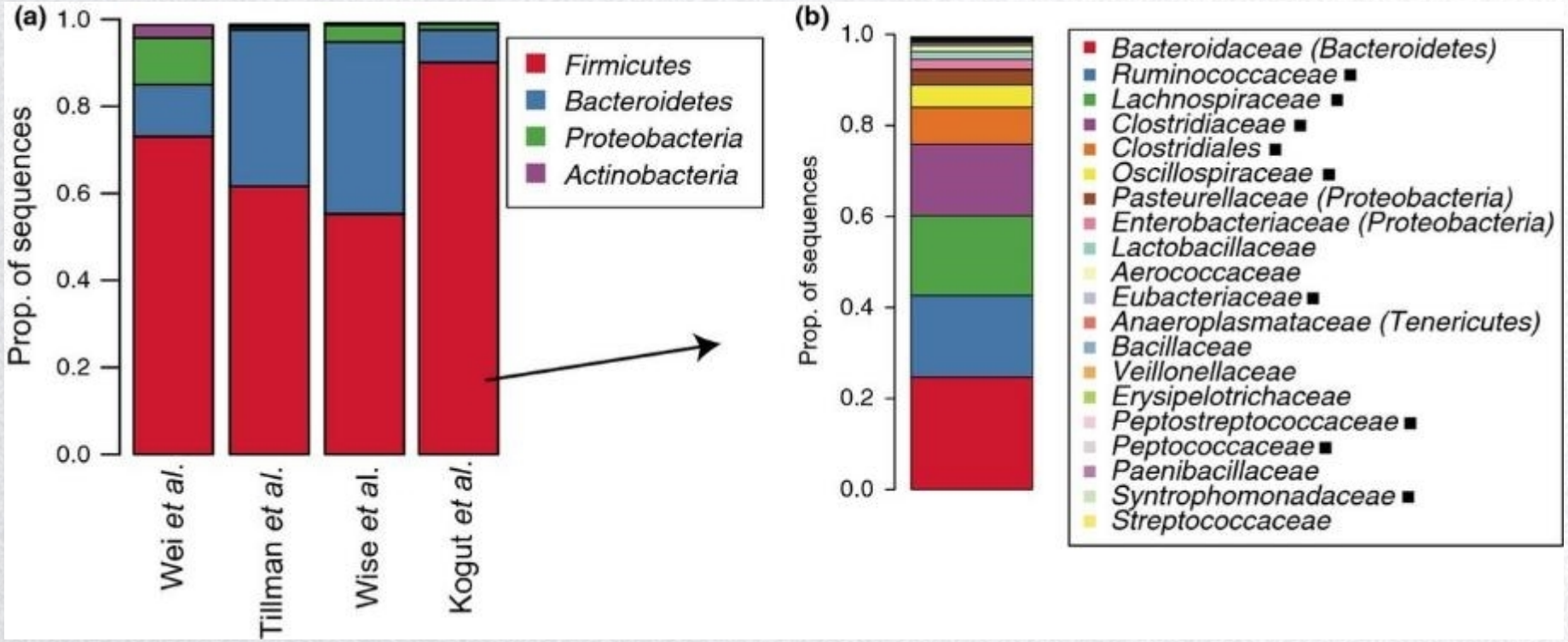

## Mortality




## Virus shedding



# Microbiota Composition in Chicken Cecum



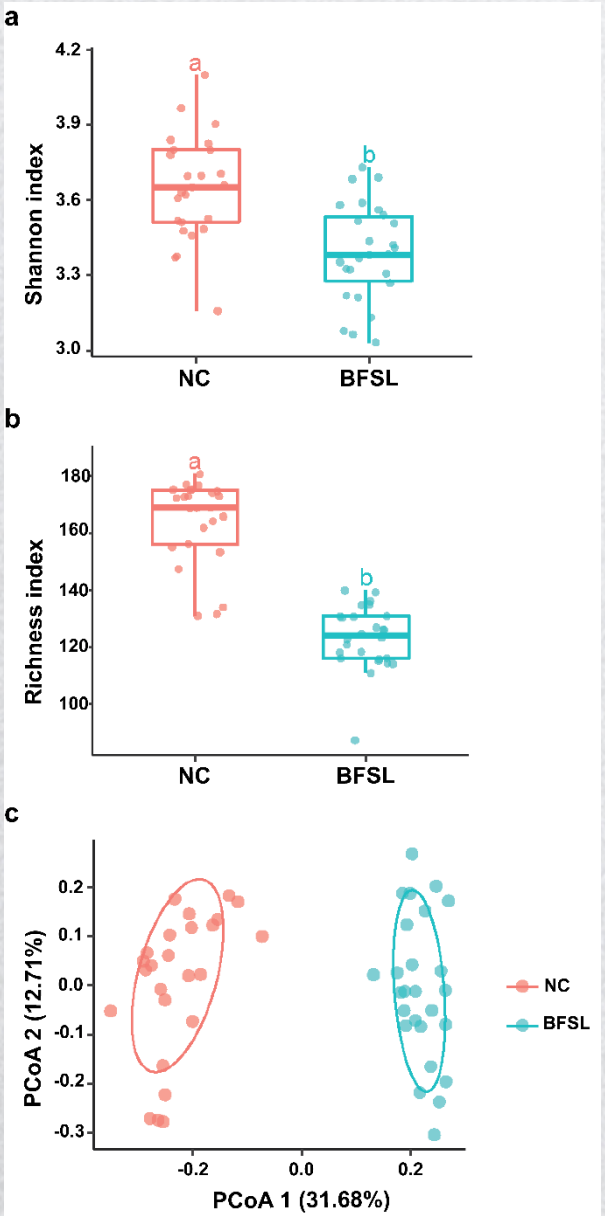

Oakley et al., 2014

## Composition:

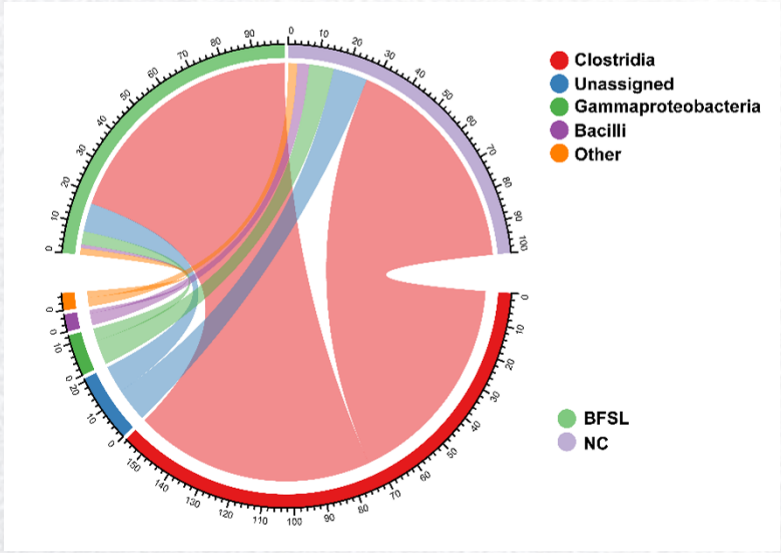
**Phylum: *Firmicutes*, *Bacteroidetes* and *Proteobacteria* are the most common, followed by *Actinobacteria*.**

**Family: Most belong to the *Clostridium* family**

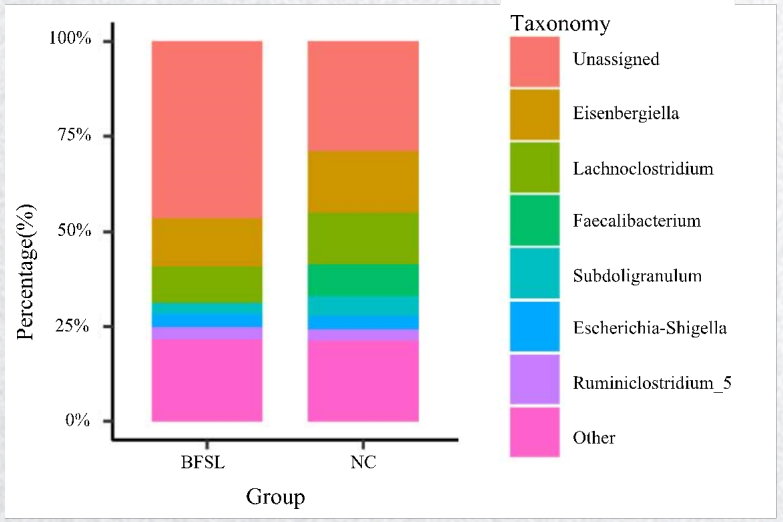
## Change in microbiome structure




## Change in class-level taxonomic composition

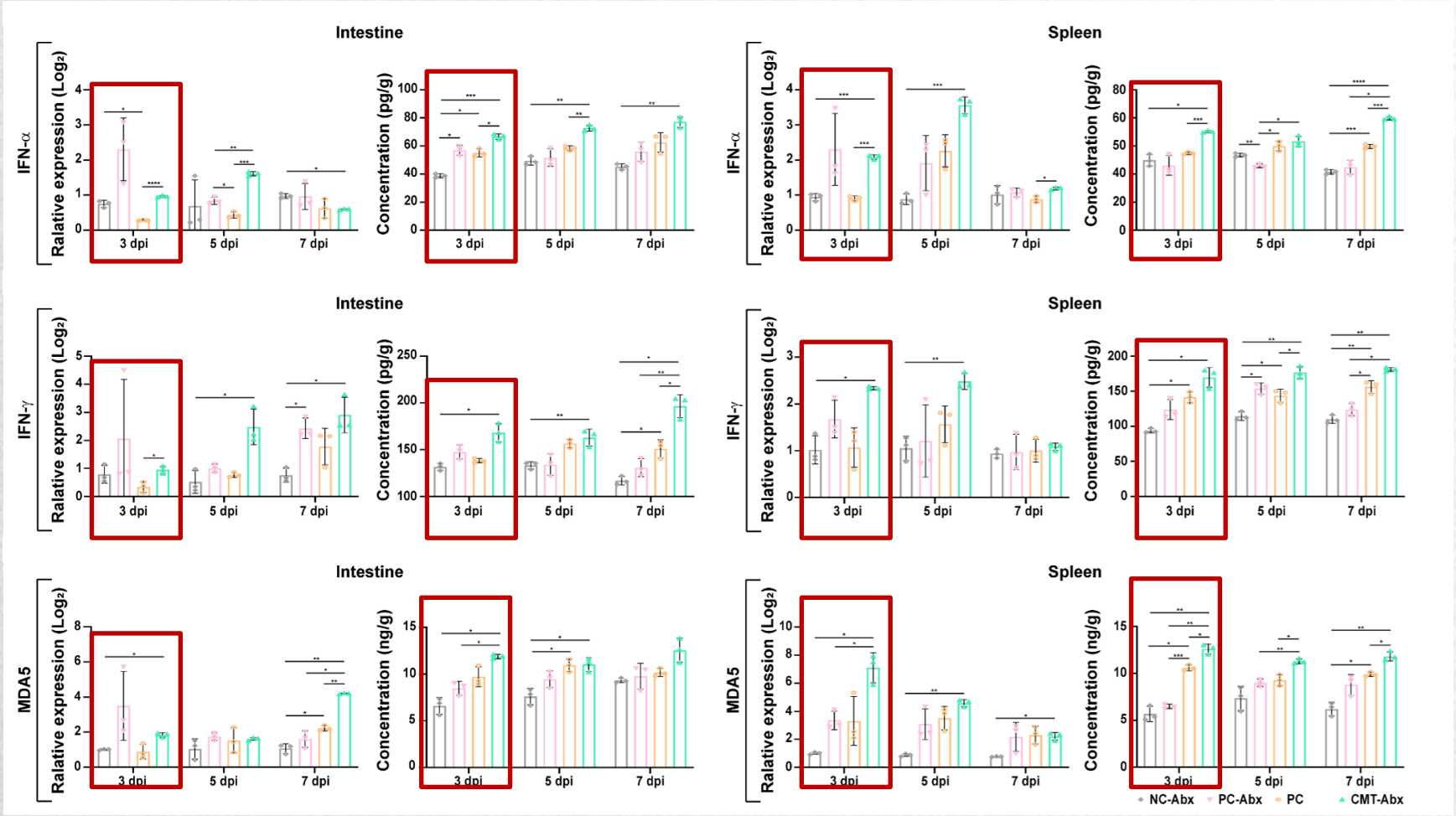



## Change in genus-level taxonomic composition



**Clostridium Transplantation:** Increased IFN-α mRNA and protein in intestine and spleen
Increased IFN-γ mRNA and protein in intestine
Increased MDA5 mRNA and protein in intestine and spleen

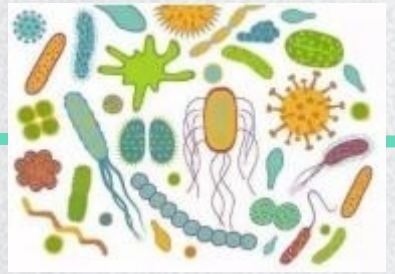
## Transcriptional and translational levels of IFN-α, IFN-γ, and MDA5



Conclusions

## Conclusions

- The inclusion of BSFL meal at a low percent (10%) of daily diet for young chickens enhances their immune response, which in turn enhances their resist to IBV.
- BFSL diet alters composition of gut microbiota of the chickens with main differences in Clostridia, etc.
- BSFL diet could enhance host immunity through affecting gut microbiota, thus benefit young chicken with resistance to coronavirus infection.



IBV resistance

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THANK YOU

# 谢谢

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