



# *Akkermansia muciniphila* enhances chicken resistance to infectious bronchitis virus by boosting GABA synthesis and suppressing the NF- $\kappa$ B inflammatory pathway

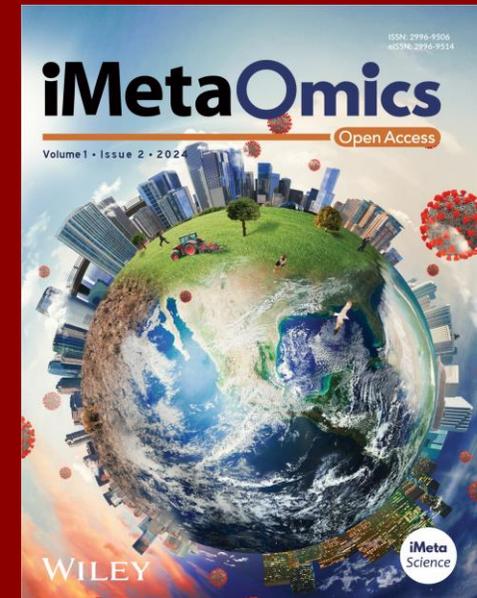
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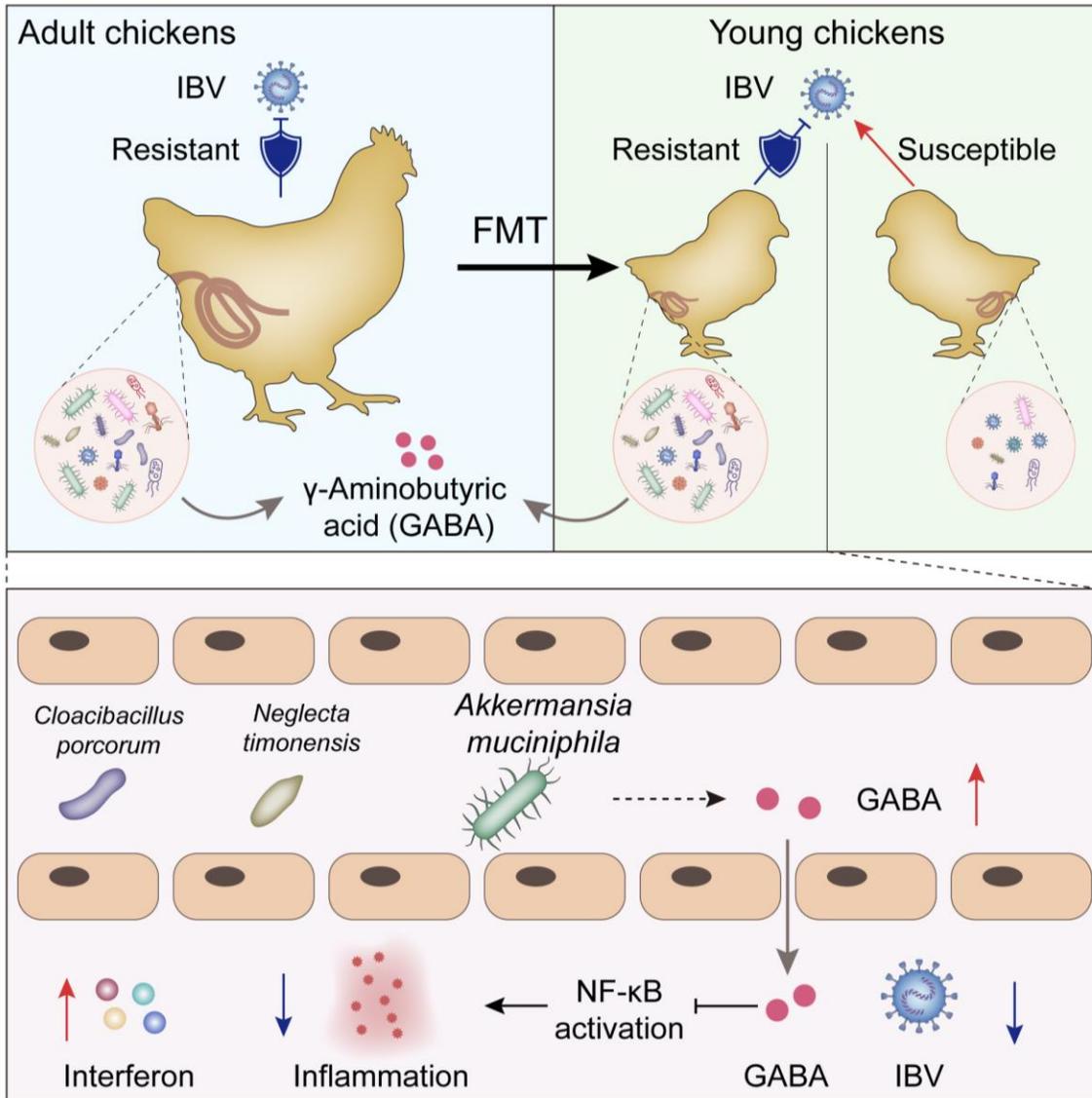
Ouyang Peng, Yufang Liu, Xuanci Wang, Yihui Huang, Yiqin Yang, Qixiang Kang, Rui Geng, et al. 2026. *Akkermansia muciniphila* enhances chicken resistance to infectious bronchitis virus by boosting GABA synthesis and suppressing the NF- $\kappa$ B inflammatory pathway. *iMetaOmics* 3: e70086. <https://doi.org/10.1002/imo2.70086>



# Background

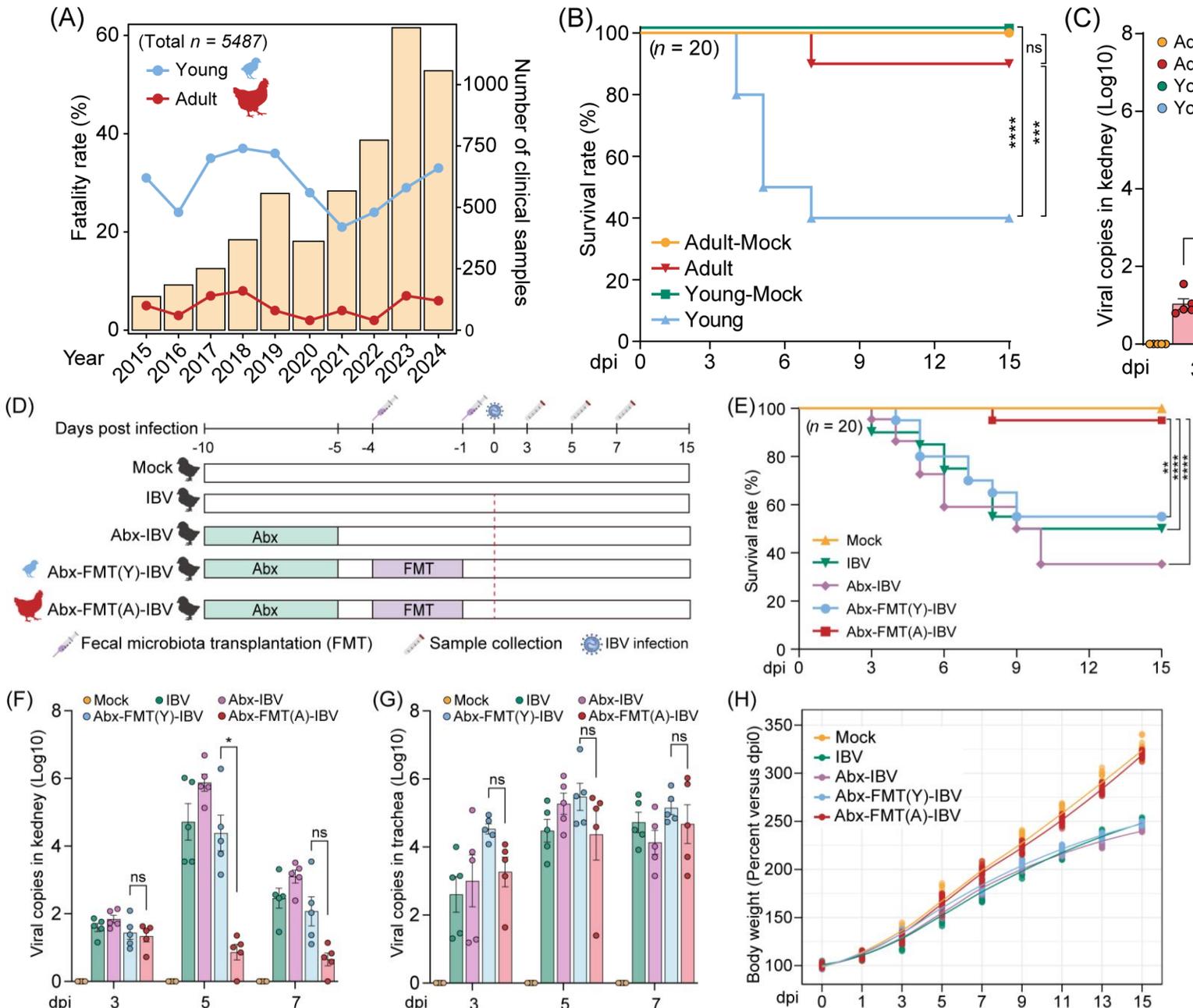
- Infectious bronchitis virus (IBV) induces respiratory diseases in chickens, transmits rapidly via air, and causes high mortality in chicks. It also shows multi-tissue tropism, triggering mottled kidney or reproductive tract damage in adult chickens. Statistically, IBV causes millions of US dollars in annual economic losses and is among the most harmful pathogens to the global poultry industry
- IBV features a high mutation rate, immune escape, and extensive genetic and serotypic diversity. Existing vaccines usually fail to provide cross-protection against new variants, leading to frequent immune failure. Moreover, no approved therapeutic drugs are available clinically. Particularly under the national antibiotic-free breeding policy, novel prevention and control strategies are urgently needed
- Intestinal microbiota plays a vital role in maintaining host health and holds potential as a novel therapeutic approach. For example, studies have confirmed that probiotics can restore intestinal microbiota homeostasis and alleviate COVID-19 symptoms

# Highlights



- By integrating microbiomics, viromics and metabolomics technologies, we systematically characterized the intestinal microecological features of adult chickens and chicks for the first time, and constructed their interaction networks
- Through comparative analysis of intestinal microbiota between adult chickens and chicks, combined with time-series microbiomic analysis in a newly established persistent IBV infection model, *Akkermansia muciniphila* (*A. muciniphila*) was identified as the key bacterium enhancing chicks' resistance to IBV infection
- *A. muciniphila* enhances host resistance to IBV by increasing GABA levels, which inhibits NF-κB-mediated excessive inflammation and promotes antiviral interferon responses
- Besides *A. muciniphila*, two novel candidate probiotics with the potential to enhance chickens' IBV resistance were also identified

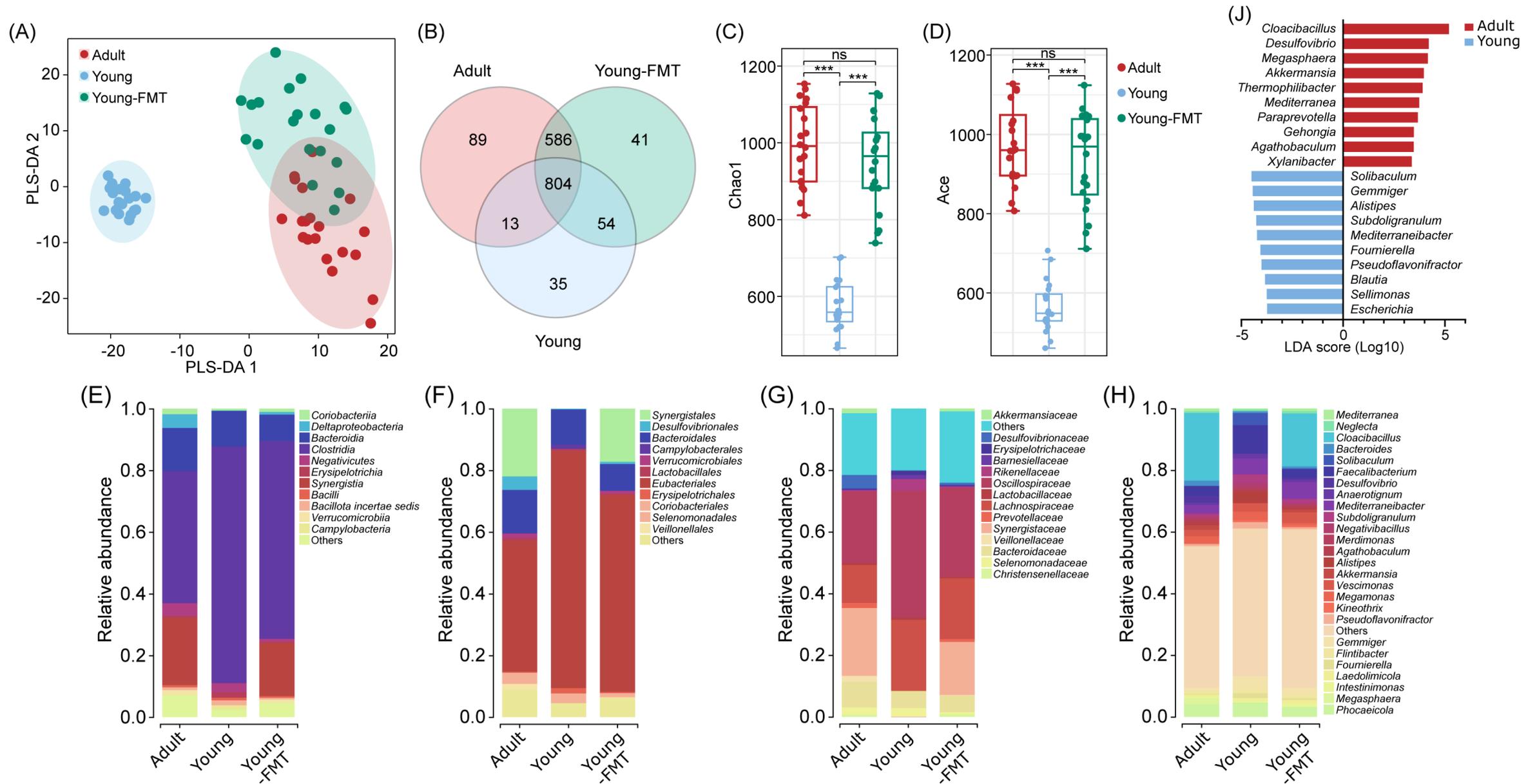
# Adult chickens exhibit higher resistance to IBV



(A) Epidemiological surveillance data from 2015 to 2024  
 (B,C) Pathological symptoms of disease status in IBV-Infected chickens  
 (D) Schematic diagram of the FMT experimental workflow  
 (E) Survival curves of chickens in different experimental groups following FMT  
 (F,G) IBV viral loads in chicken kidney and trachea  
 (H) Body weight changes in chickens across experimental groups

**Figure 1 FMT from adult chickens enhances resistance to IBV in young chickens**

# Microbiota structure in adult and young chickens



**Figure 2** 16S rRNA gene sequencing analysis of gut microbiota in adult chickens, young chickens, and FMT-treated young chickens

# Microbiota structure in adult and young chickens

(I)

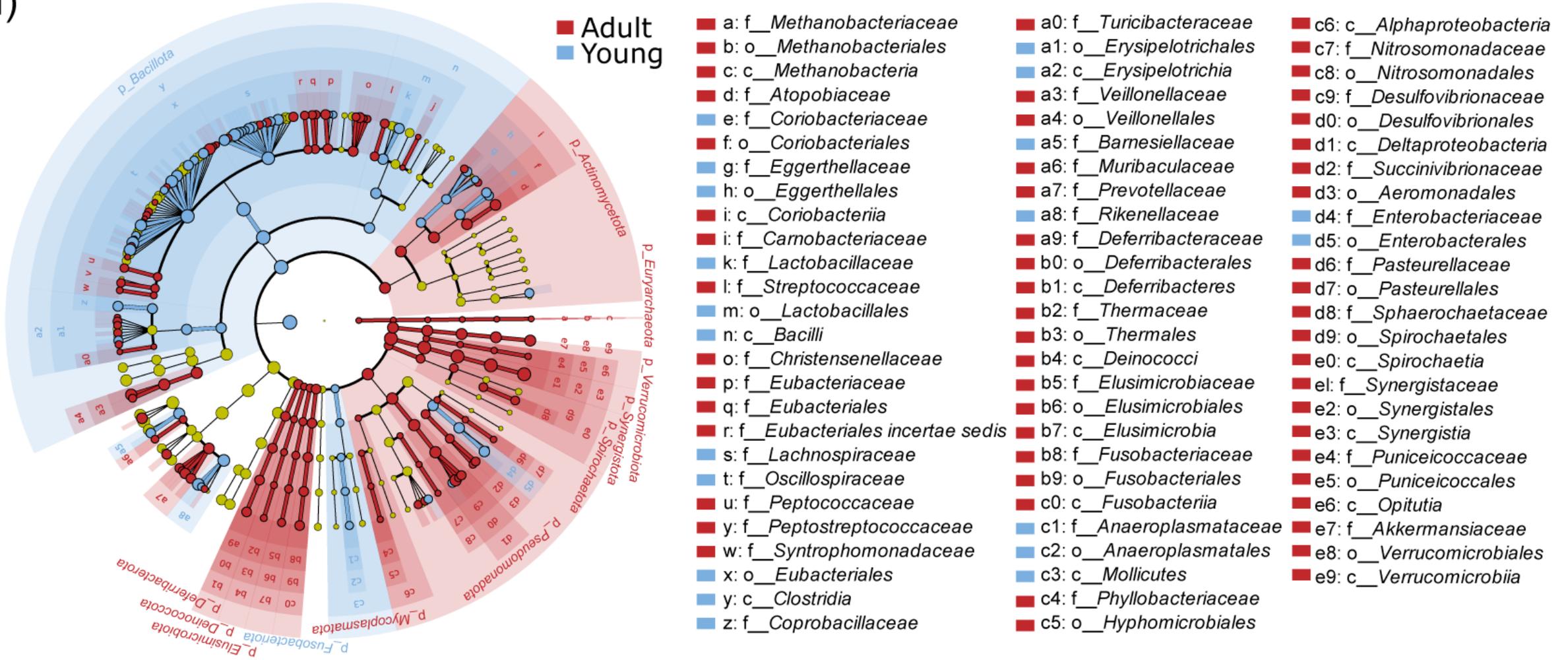


Figure 2 16S rRNA gene sequencing analysis of gut microbiota in adult chickens, young chickens, and FMT-treated young chickens



# Virome structure in adult and young chickens

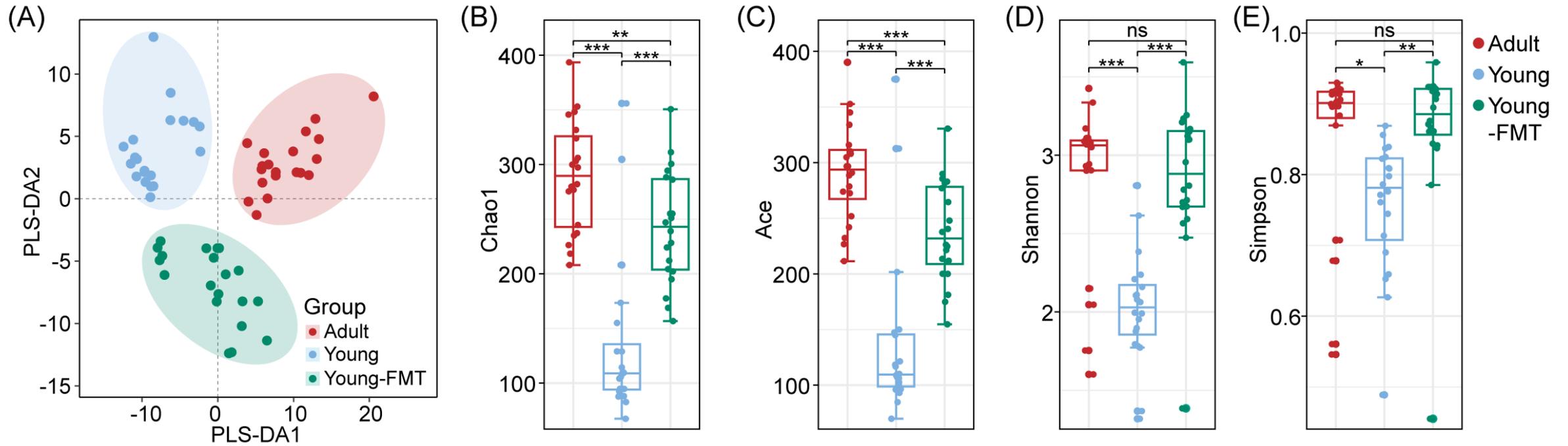


Figure 3 Viromic analysis of gut samples from adult chickens, young chickens, and FMT-treated young chickens

# Virome structure in adult and young chickens

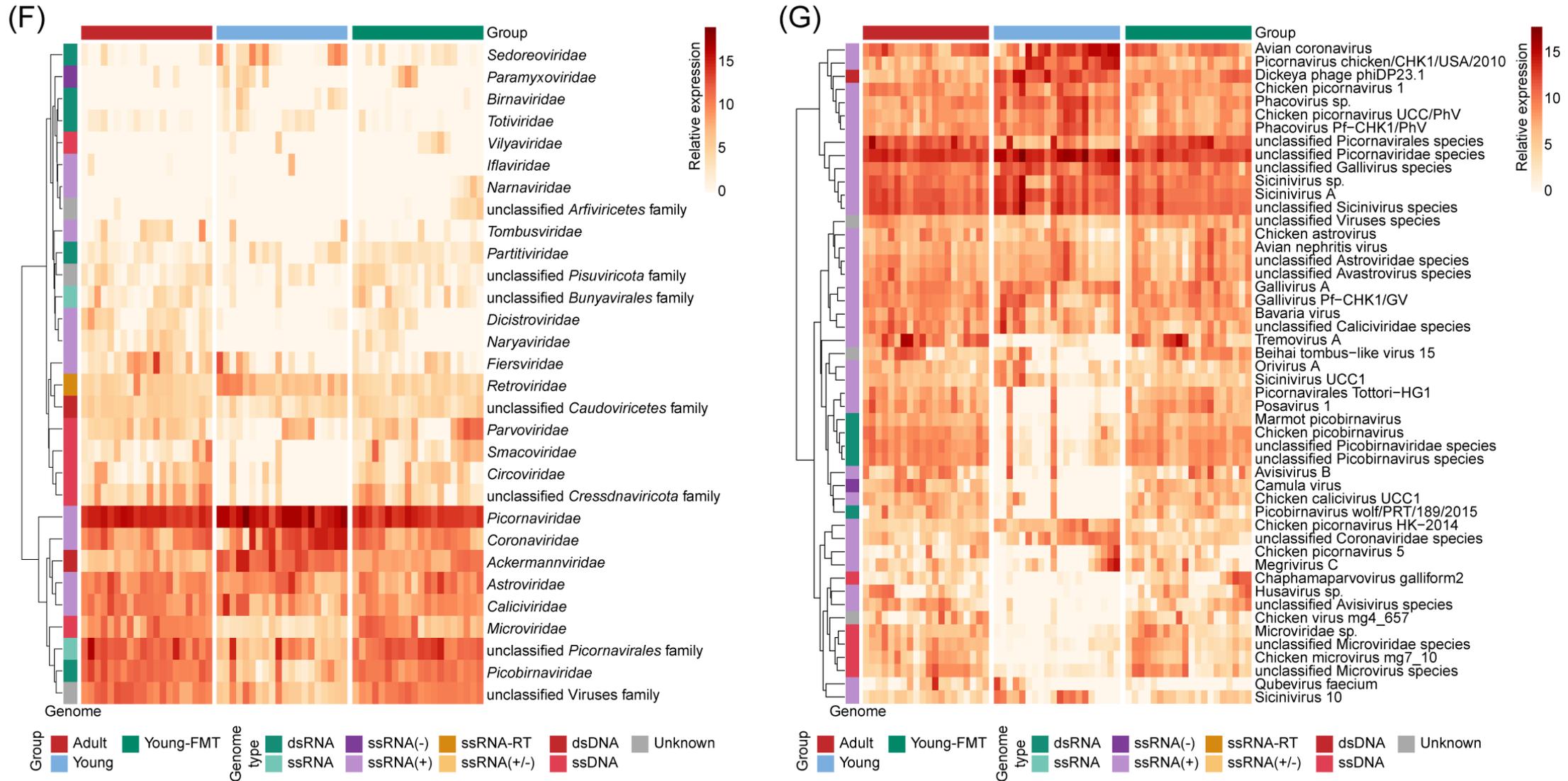
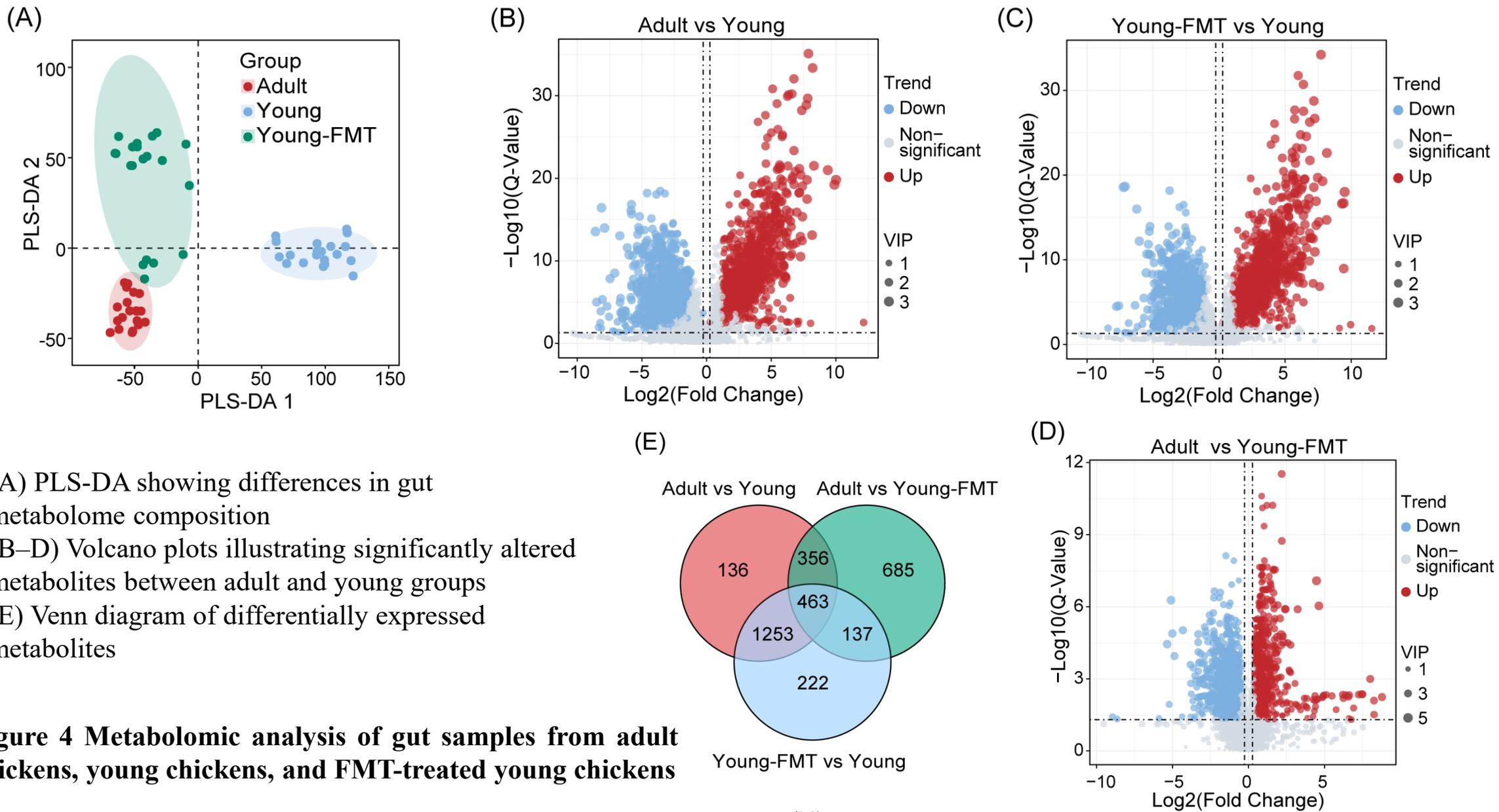


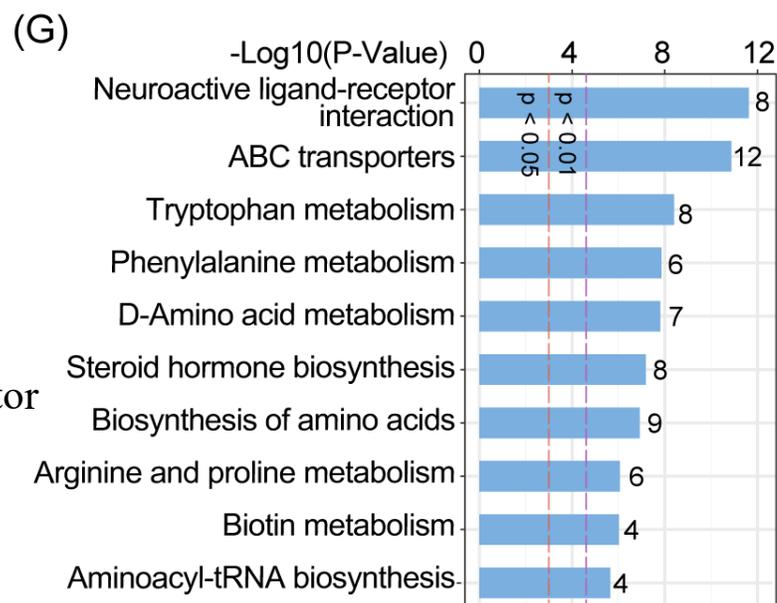
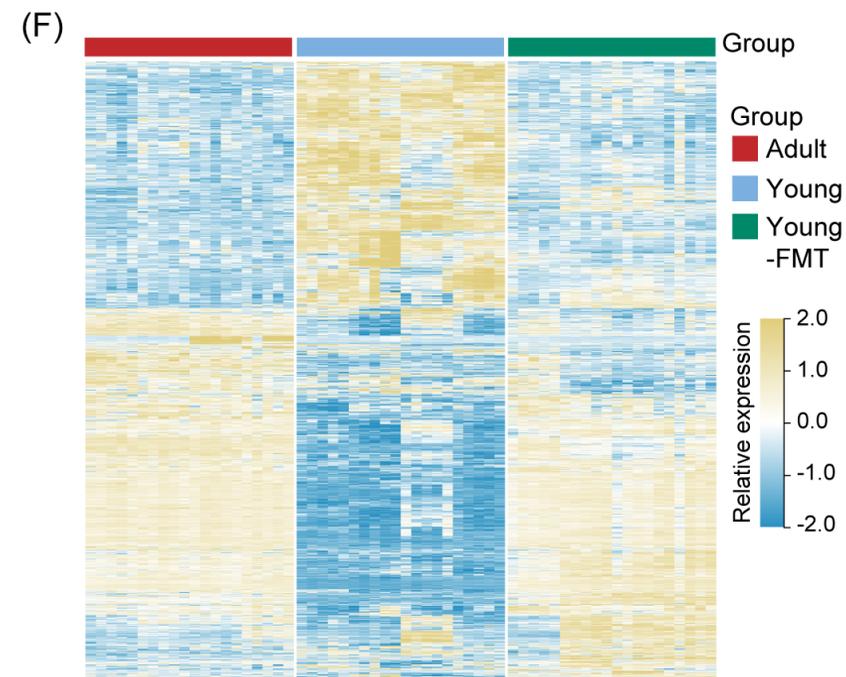
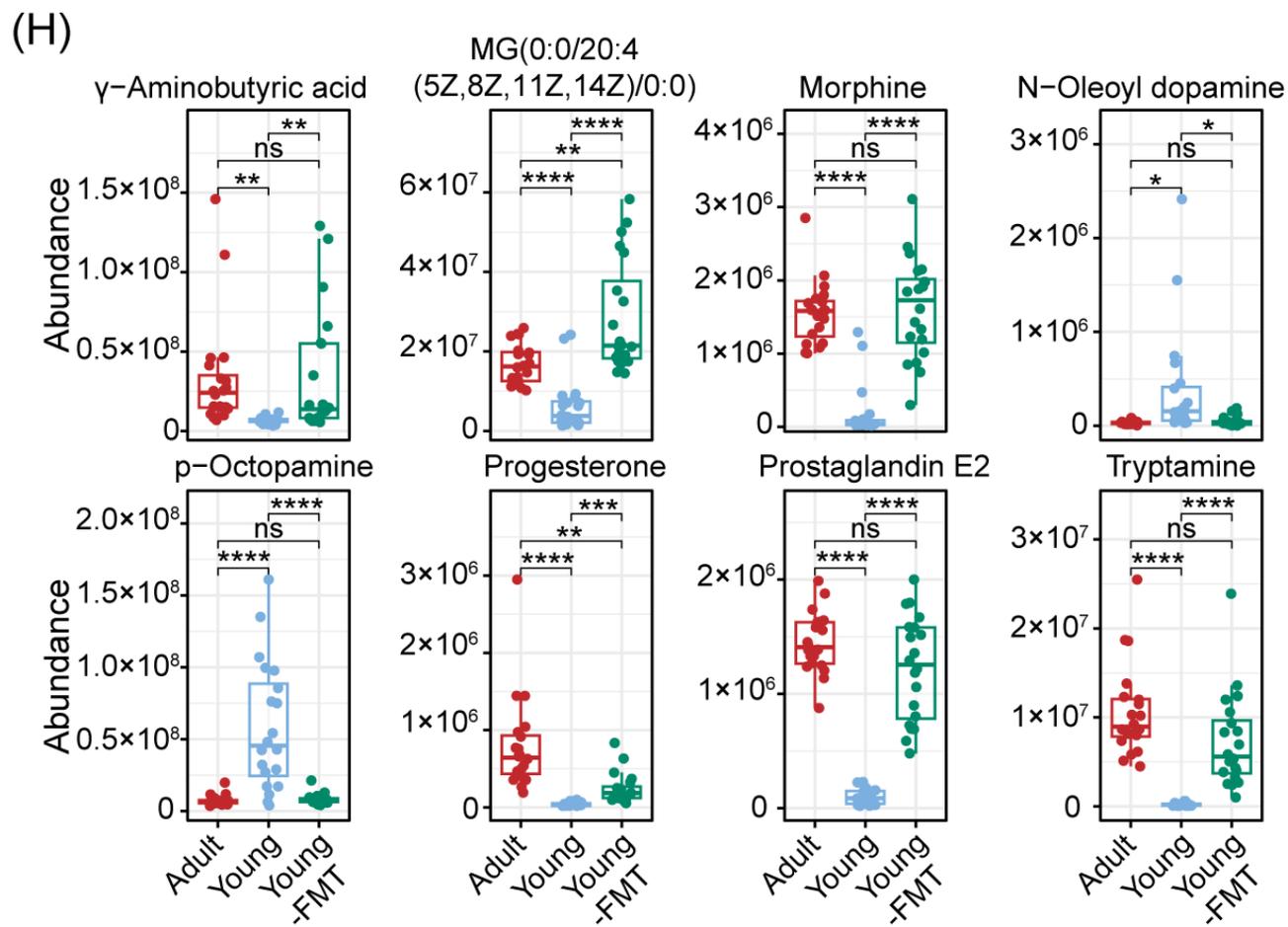
Figure 3 Viromic analysis of gut samples from adult chickens, young chickens, and FMT-treated young chickens

# Metabolome structure in adult and young chickens



**Figure 4 Metabolomic analysis of gut samples from adult chickens, young chickens, and FMT-treated young chickens**

# Metabolome structure in adult and young chickens



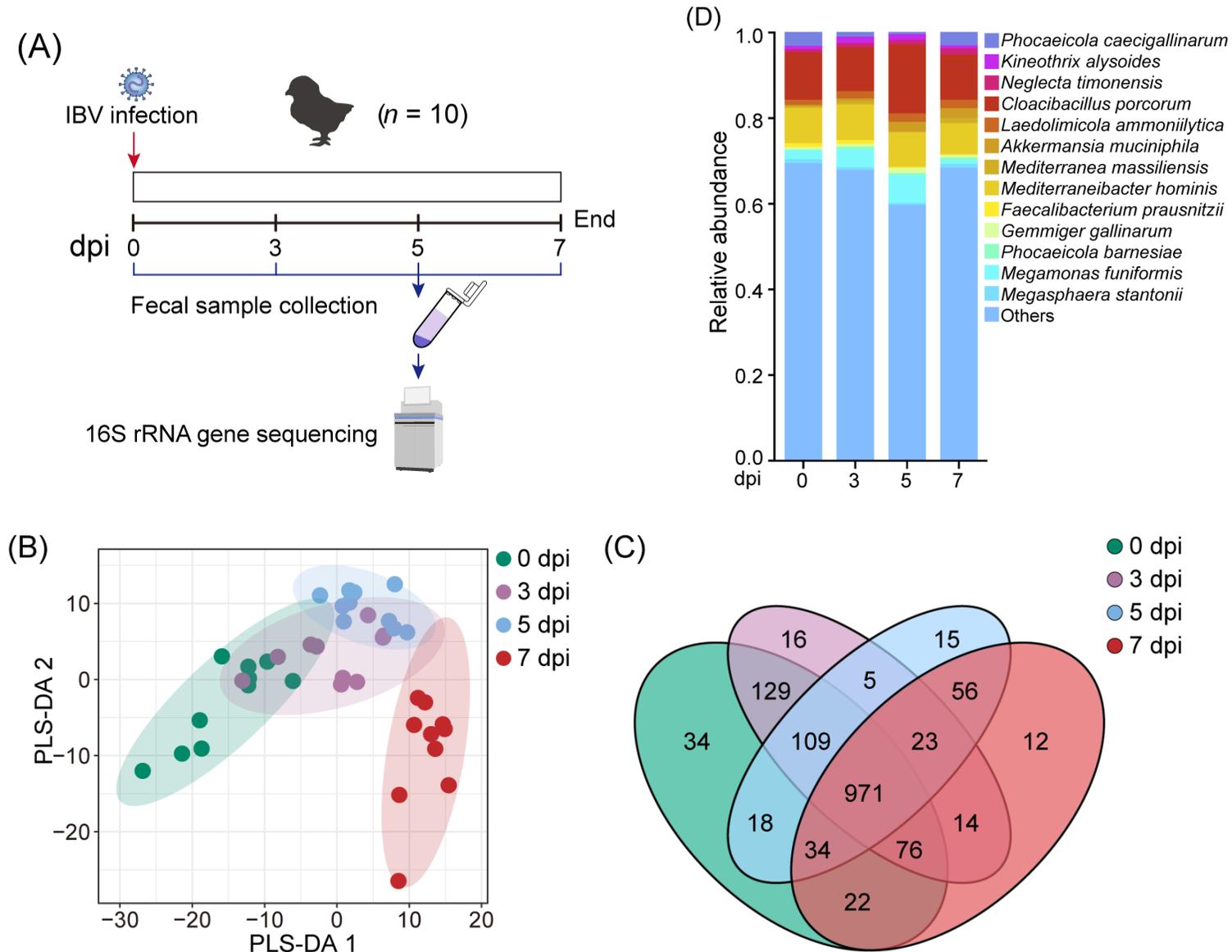
(F) Heatmap of metabolites relative expression level

(G) KEGG functions of differentially expressed metabolites between adult and young groups

(H) Abundance of 8 differentially expressed metabolites in neuroactive ligand-receptor interaction pathway

**Figure 4 Metabolomic analysis of gut samples from adult chickens, young chickens, and FMT-treated young chickens**

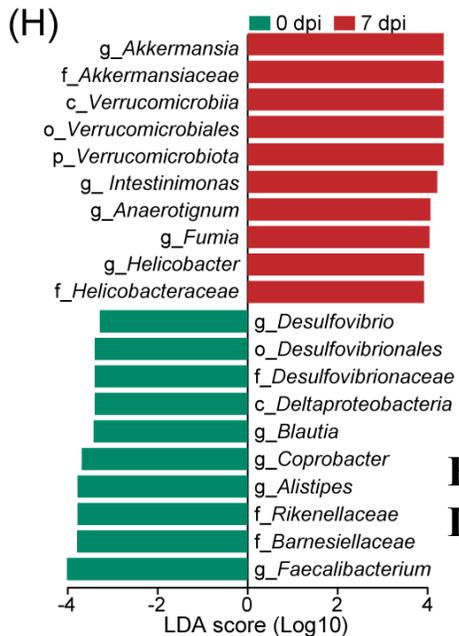
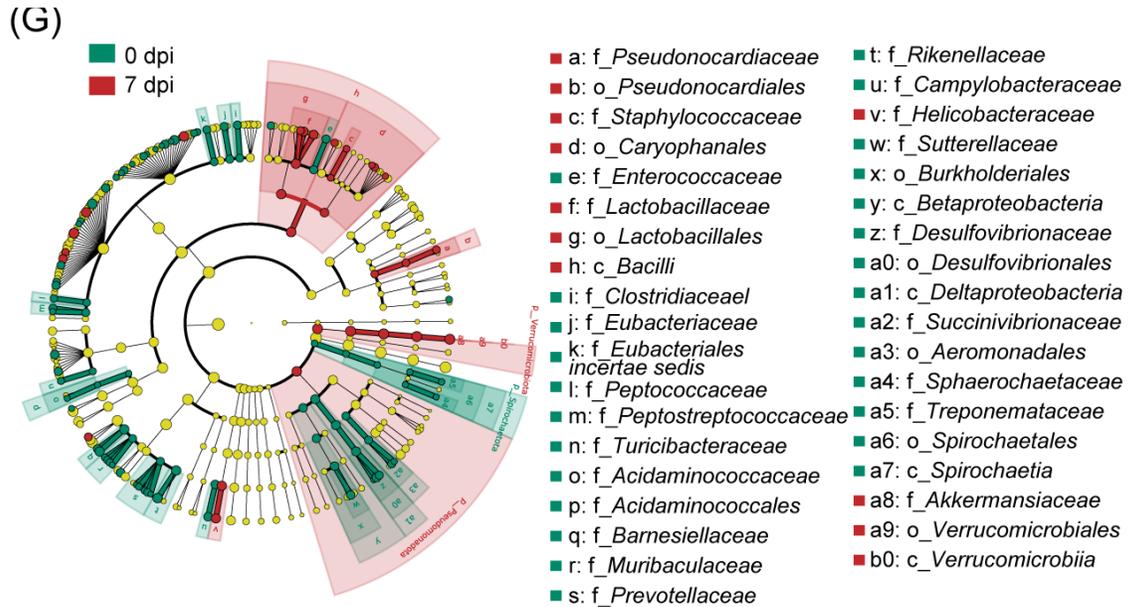
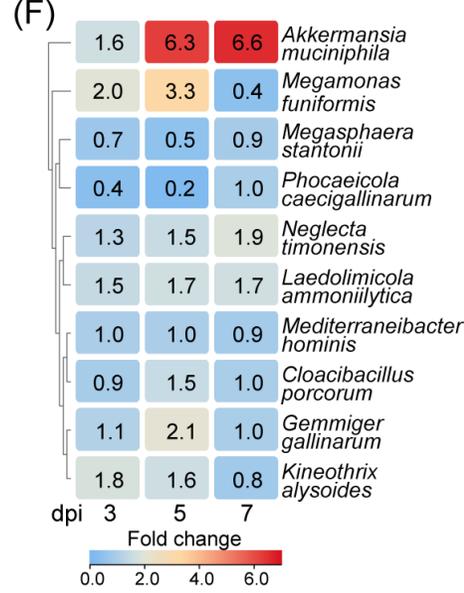
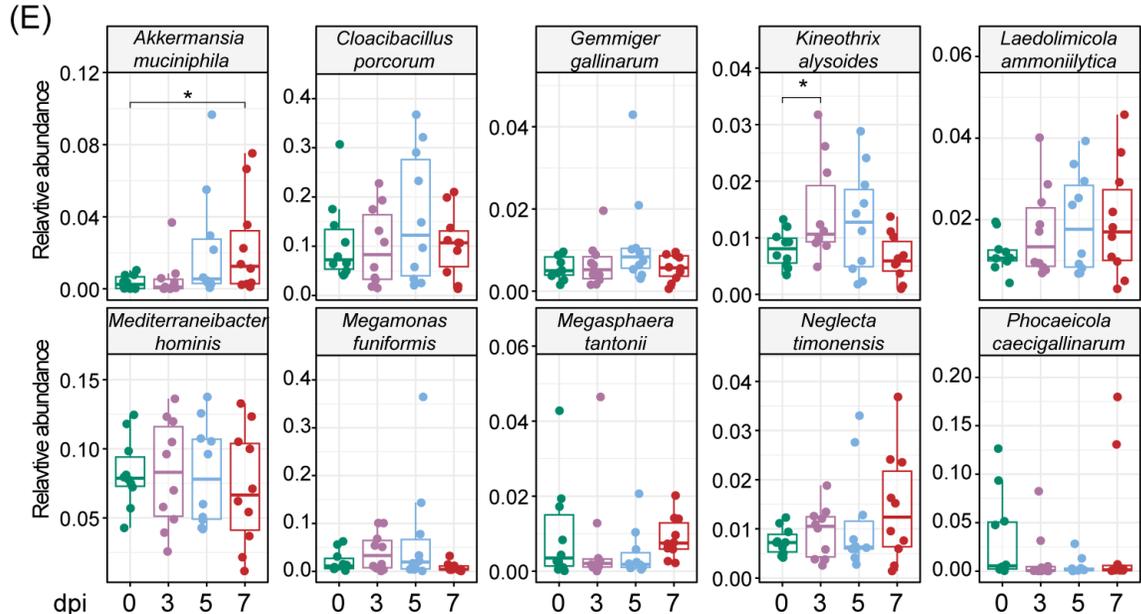
# *A. muciniphila* is a key post-infection biomarker



(A) Experimental workflow of the persistent IBV infection model  
(B) PLS-DA showing differences in gut microbiota composition  
(C) Venn diagram illustrating shared and unique OTUs  
(D) Stacked bar plots showing microbiome composition at the species level

Figure 5 Gut microbiome analysis in a persistent IBV infection model in young chickens

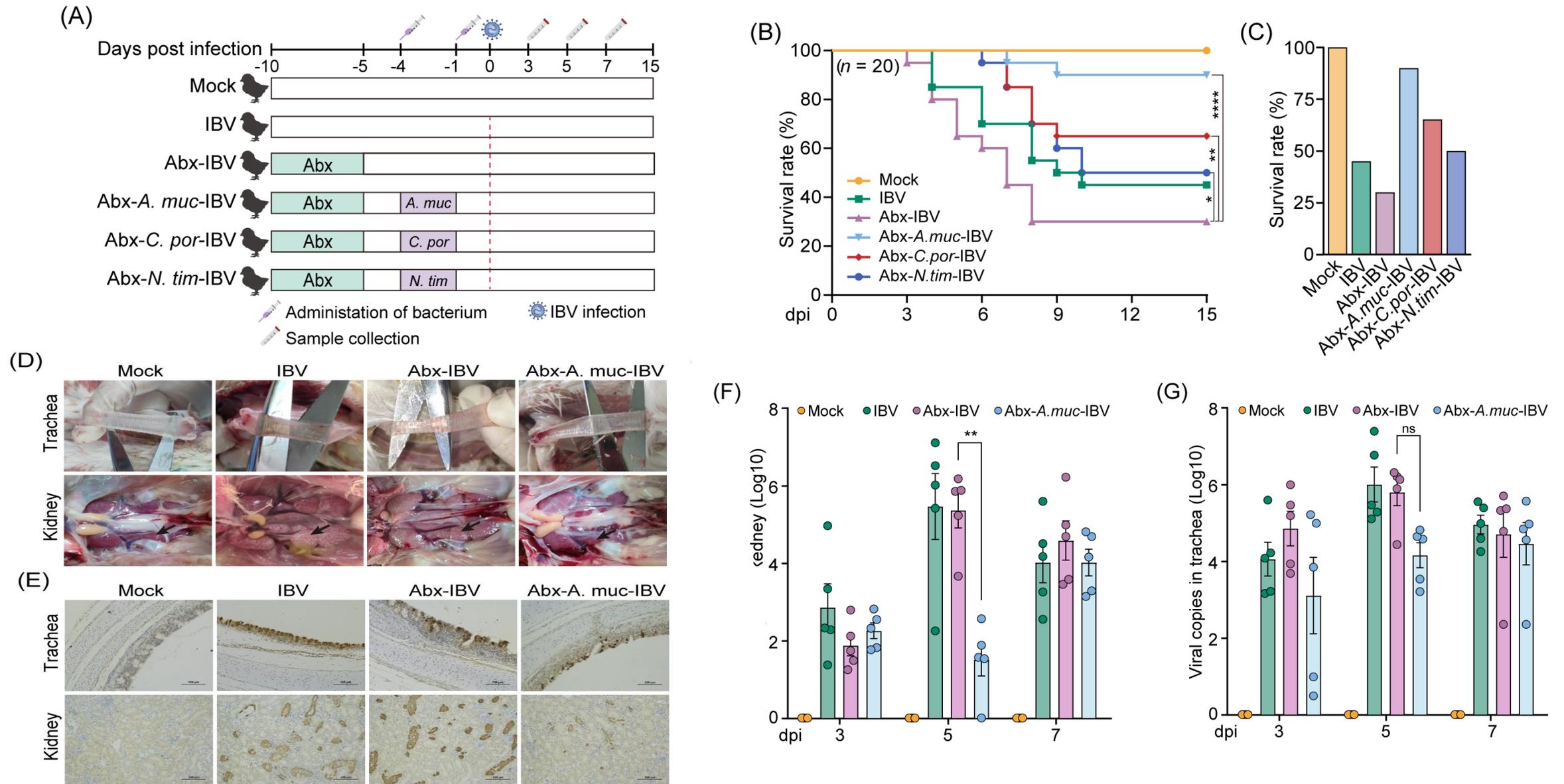
# A. muciniphila is a key post-infection biomarker



(E) Bar plots illustrating abundance changes of the top 10 most abundant microbes before and after IBV infection  
 (F) Heatmap showing fold changes in the top 10 abundant microbes  
 (G) LEfSe analysis identifying significant microbial biomarkers  
 (H) Top 10 taxa with the highest LDA scores

**Figure 5 Gut microbiome analysis in a persistent IBV infection model in young chickens**

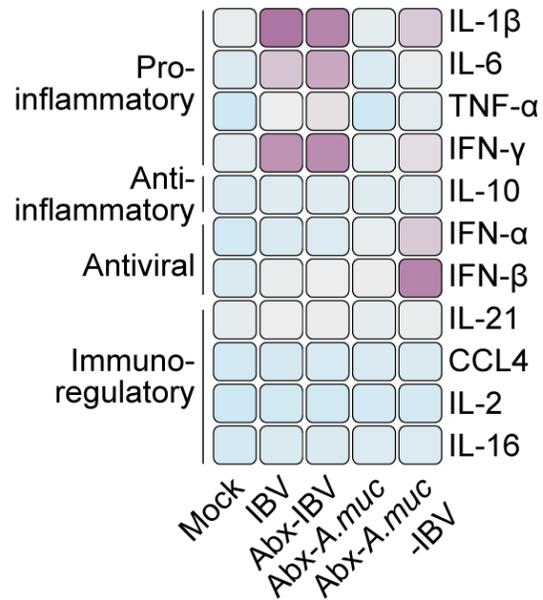
# *A. muciniphila* enhances resistance by modulating GABA



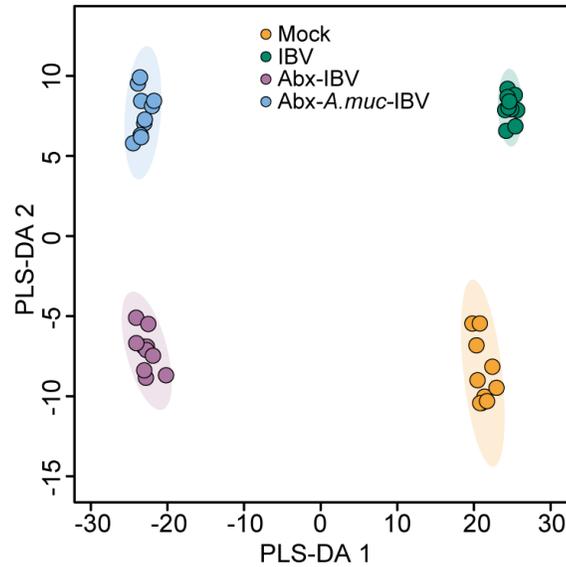
**Figure 6** Oral administration of *A. muciniphila* significantly enhances resistance to IBV infection in young chickens

# *A. muciniphila* enhances resistance by modulating GABA

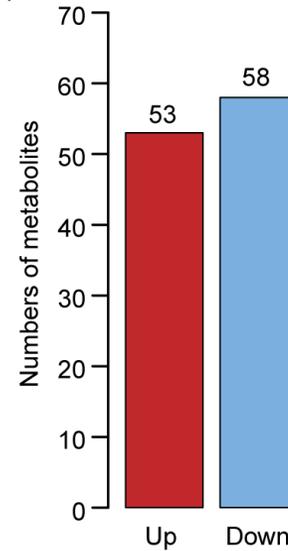
(H)



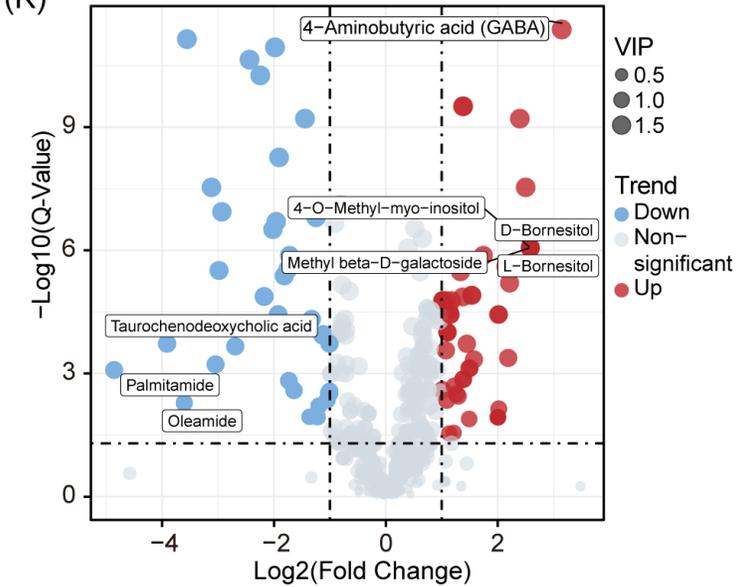
(I)



(J)



(K)



(H) Heatmap of cytokine expression levels in blood samples

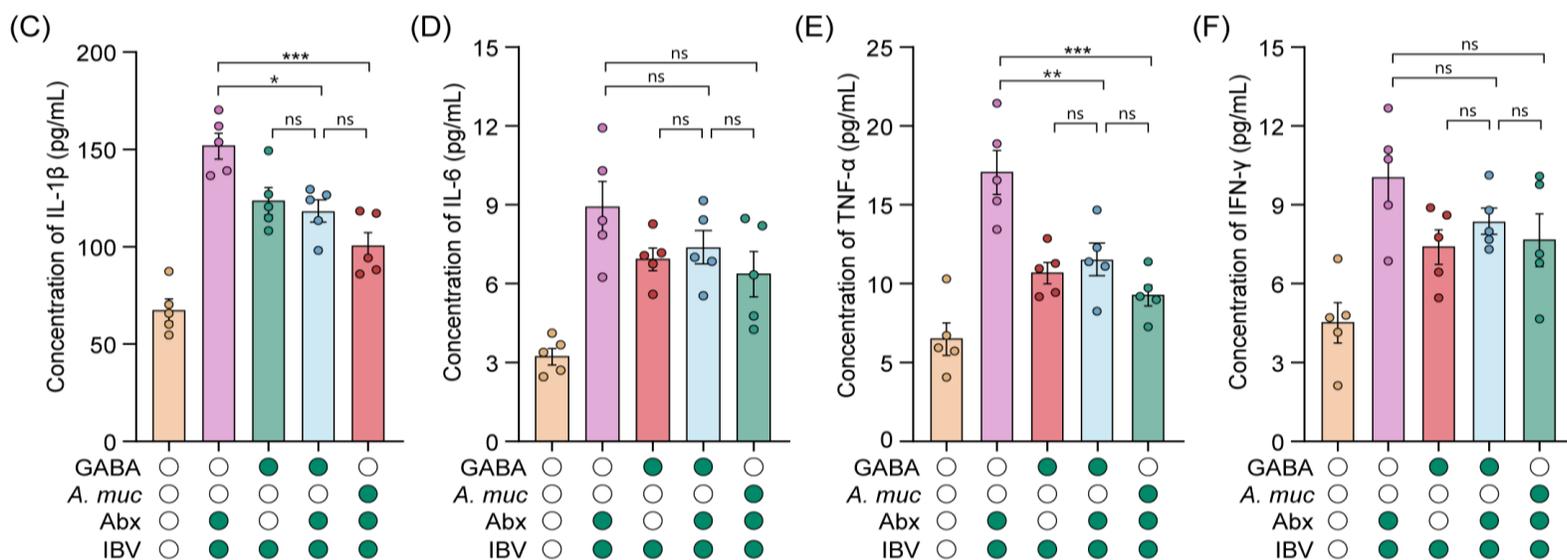
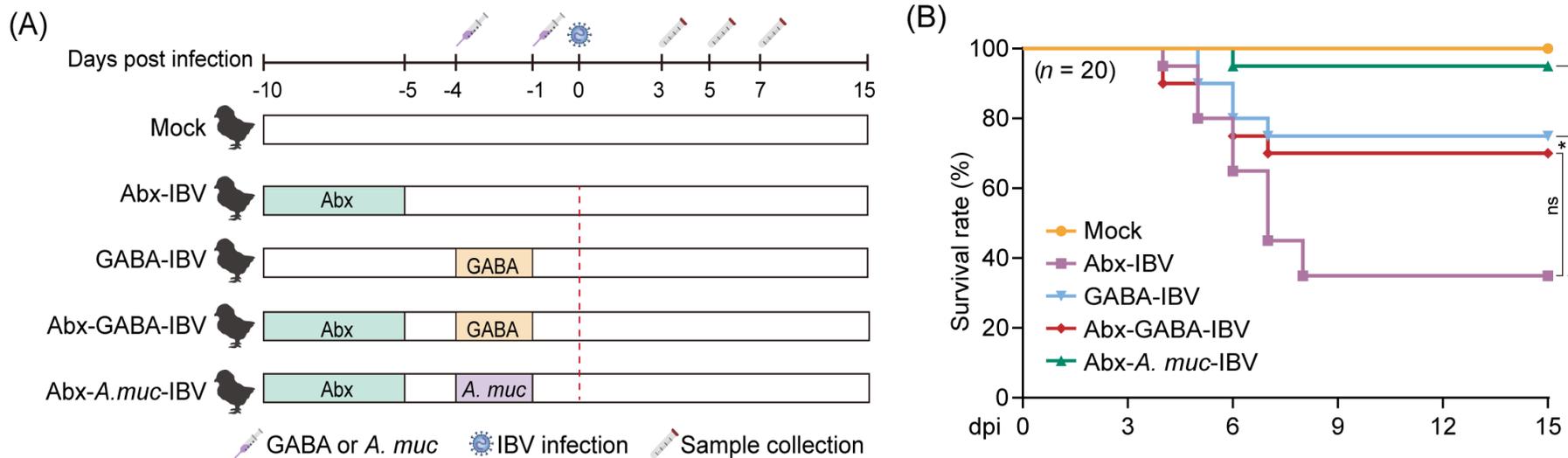
(I) PLS-DA plot of metabolomic profiles in fecal samples

(J) Bar plot of differentially expressed metabolites

(K) Volcano plot of differentially expressed metabolites

**Figure 6 Oral administration of *A. muciniphila* significantly enhances resistance to IBV infection in young chickens**

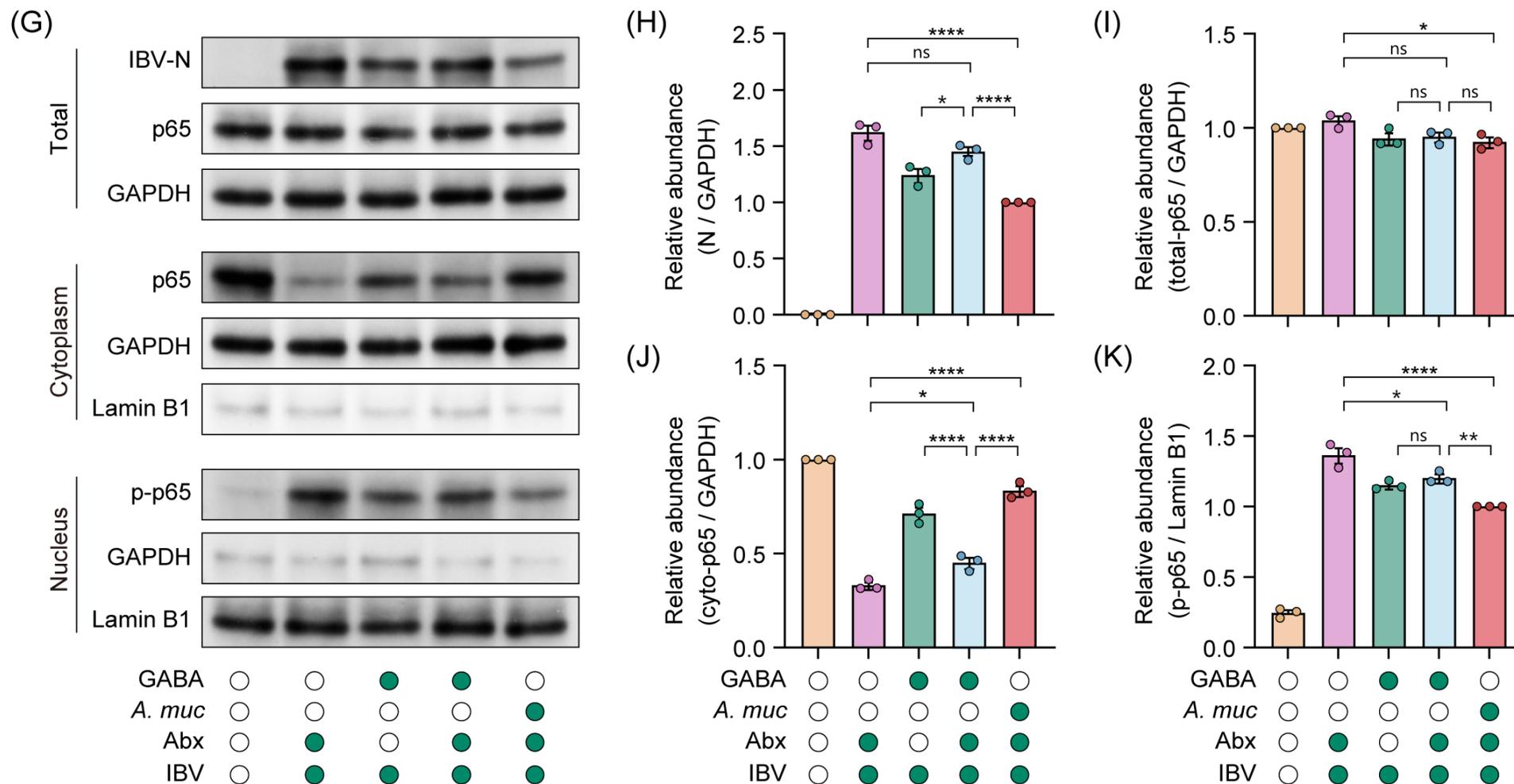
# GABA promotes resistance by inhibiting inflammation



(A) Schematic diagram of the animal experiment workflow  
 (B) Survival curves of young chickens following IBV infection  
 (C–F) Expression levels of inflammatory factors by ELISA

**Figure 7** *A. muciniphila* enhances resistance to IBV infection in young chickens through GABA

# GABA promotes resistance by inhibiting inflammation



(G) Western blot analysis in chickens administered of GABA and *A. muciniphila* following IBV infection  
 (H–K) Relative abundance o in cytoplasm and nucleus sample

**Figure 7 *A. muciniphila* enhances resistance to IBV infection in young chickens through GABA**



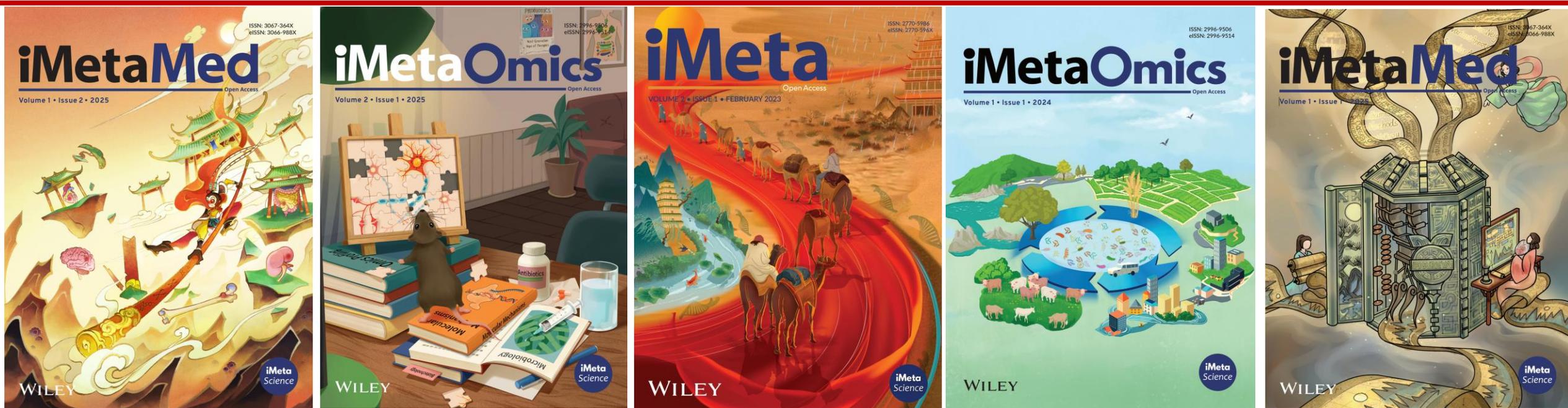
# Summary

- ❑ In this study, we systematically conducted a comprehensive analysis of the intestinal microbiota in chickens of different ages through multi-omics, revealing the dynamic changes in the intestinal microbiome, intestinal virome, and intestinal metabolites with age.
- ❑ We identified the key probiotic *A.muciniphila* and the prebiotic GABA, which are closely related to IBV infection. They maintain the integrity of the intestinal barrier by inhibiting the inflammatory response caused by IBV infection, thereby helping the body resist IBV infection.
- ❑ Our research provides new insights into how *A.muciniphila* produces IBV resistance through GABA-mediated immune regulation and offers a new paradigm for microbiota-driven antiviral strategies.

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