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# PAG 2017 poster _Jibin Zhang.pdf

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# Transcriptome Analysis Reveals Distinct Immune Responses to Newcastle Disease Virus in Spleen Between Resistant and Susceptible Chicken Lines

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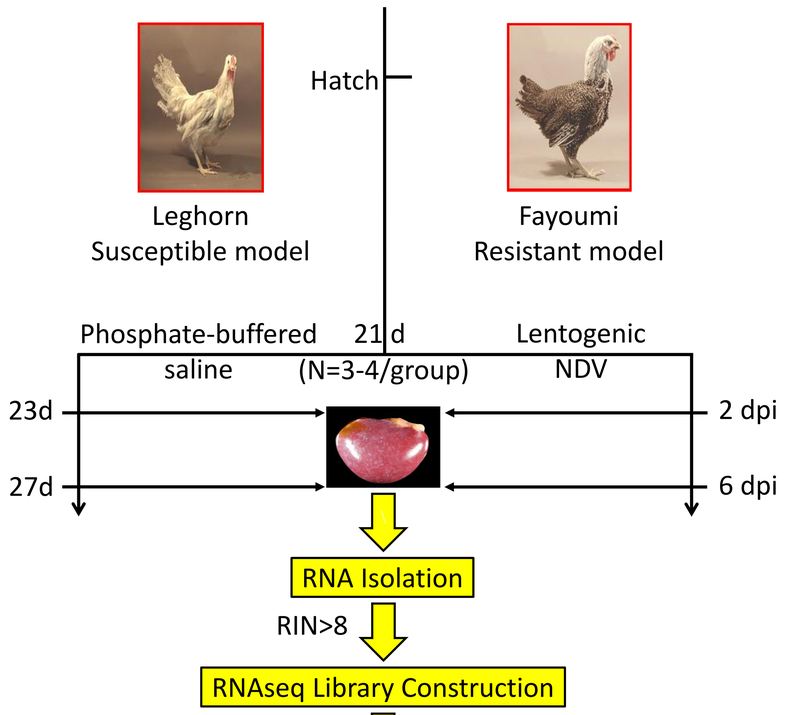
## Introduction

- As a major infectious disease in poultry, Newcastle disease has caused:
  - I. Considerable economic loss in poultry industry worldwide
  - II. Serious problem in some rural areas where chickens are a significant source of income and nutrition [1]
- Vaccination is an important strategy to prevent the disease but is not always executable or effective due to:
  - I. Lack of cold chain and proper management in rural communities in African and Asia[2]
  - II. Evolution and diversity of Newcastle disease virus (NDV) [3]
- Selection and breeding provides a promising approach to enhance resistance to the disease so that[4]
  - I. Global poultry industry productivity will be increased
  - II. Poverty and food insecurity in developing countries will be alleviated
- Two objectives of this study:
  - I. Identify genes and pathways regulating host response to NDV
  - II. Identify genes and pathways related to distinct genetic resistance between the two inbred chicken lines

## Methods




## Results

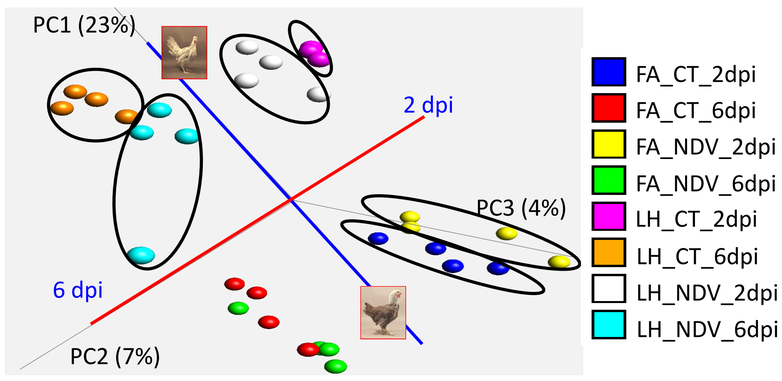



**Figure 1.** Samples separated well between Fayoumi (FA) and Leghorn (LH), 2 and 6dpi, and NDV challeneged and non-challenged (CT) chickens (except FA 6dpi) in PCA plot.

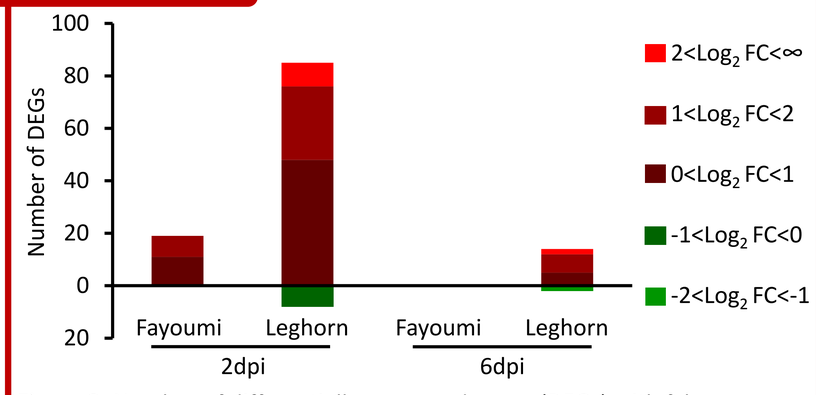



**Figure 2.** Number of differentially expressed genes (DEGs) with false discovery rate (FDR) <0.05 for NDV vs. CT contrast in two chicken lines at two time points.

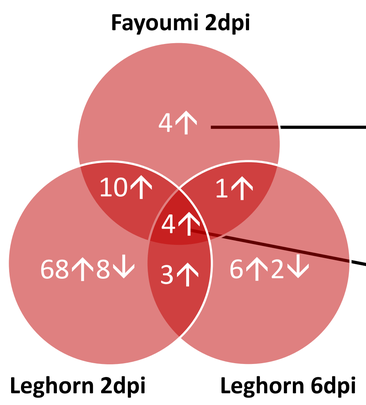



**Figure 3.** Overlapped and unique DEGs with FDR<0.05 for NDV vs. CT in different groups.

**Table 1. Four unique DEGs in Fayoumi at 2dpi**

| Gene Name | Function |
|---|---|
| PLA2R1 | Contribute to antibody formation and complement activation [7] |
| GLUL | Catalyzes the synthesis of glutamine from glutamate and ammonia [8] |
| GPT2 | Catalyze the synthesis of pyruvate and glutamate [8] |
| CFHR2 | Regulates Complement Activation [9] |

**Table 2. Four shared DEGs in all groups**

| Gene Name | Function |
|---|---|
| IFIT5 | A key antiviral protein that can enhance innate immune signaling pathways [10] |
| Mx | Participates in the cellular antiviral response [11] |
| CMPK2 | Tight correlation with macrophage activation and inflammatory response [8] |
| USP18 | A major negative regulator of IFN signaling [12] |

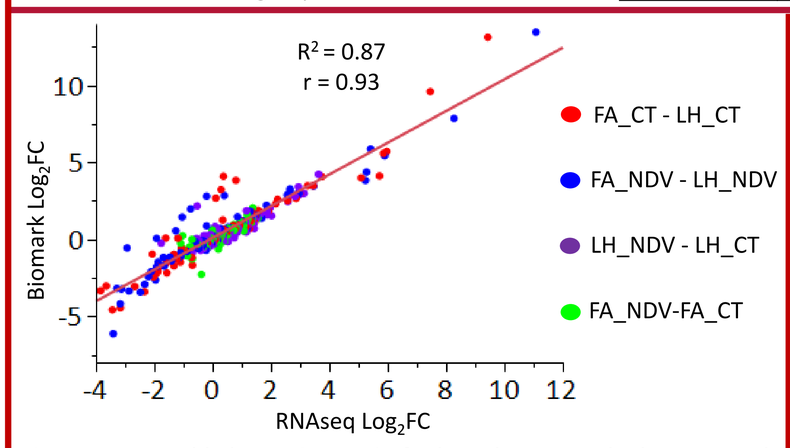



**Figure 4.** $Log_2$ Fold Change ($Log_2FC$) of selected genes in Fluidigm Biomark qPCR showed high consistence with that in RNAseq for different comparisons.

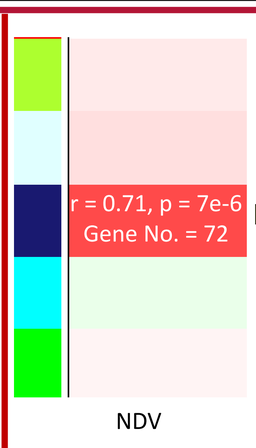



**Table 3. Gene Annotation Enrichment Analysis**

| Gene Ontology Terms | Enrichment Score (-log10 BH adjusted p-value) |
|---|---|
| Defence response to virus | 17.11 |
| Type-I interferon signaling | 8.82 |
| Innate immune response | 2.8 |

**Figure 5.** Genes in tan module which showed high correlation with NDV treatment in co-expression analysis showed significant enrichment in several immune-related gene ontologies.

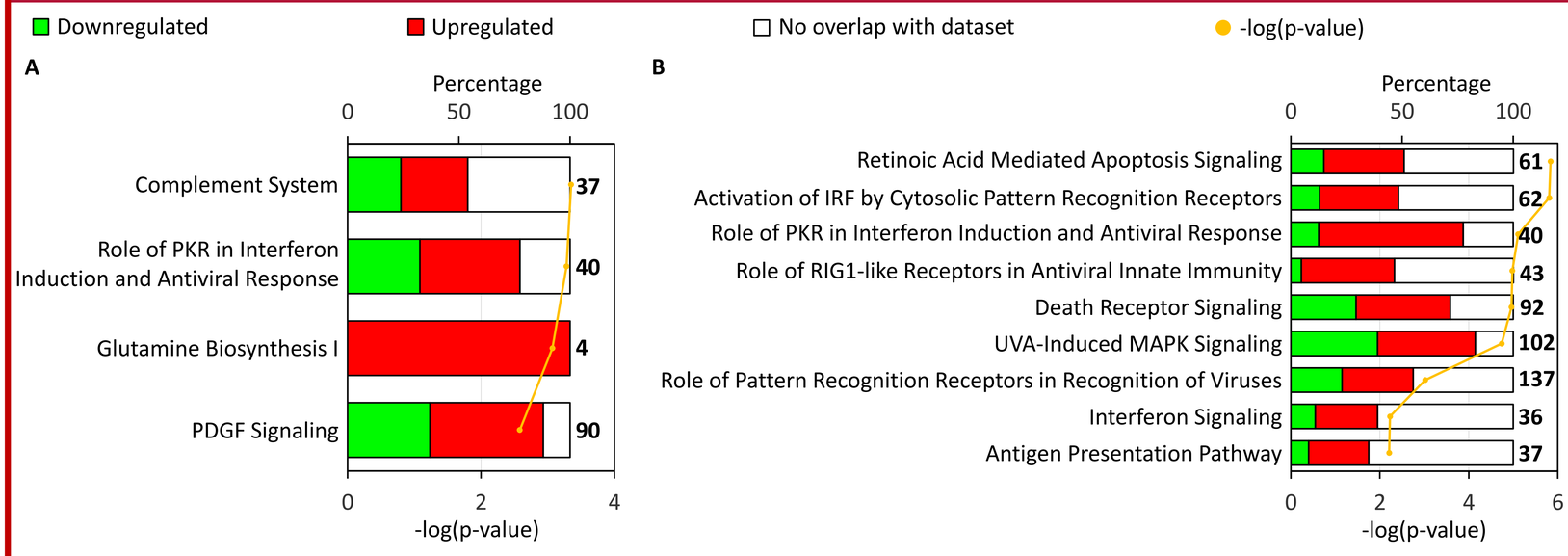



**Figure 6.** Top significant pathways (p<0.01) predicted by IPA in response to NDV in Fayoumi (**A**) and Leghorn chickens (**B**) at 2dpi**.** Each bar shows percentage of downregulated (green color) and upregulated genes (red color) compared to the total gene number labeled at the right end.

## Conclusion

- Response of gene expression to NDV challenge decreases with time in both chicken lines, but Leghorn has more dramatic response to NDV challenge than Fayoumi at both time points.
- IFIT5, Mx, CMPK2 and USP18 are commonly upregulated in NDV challenged birds, indicating their universal role in regulating immune response to NDV in chicken spleen.
- PLA2R1, GLUL, GPT2 and CFHR2 are uniquely upregulated in NDV challenged Fayoumi chickens at 2dpi. They may play a key role in enhancing genetic resistance to NDV and therefore be potential targets for breeding of NDV resistant chickens.
- WGCNA co-expression analysis revealed a module positively related to NDV challenge. Gene annotation enrichment analysis with this module suggested enhanced innate immune response against viral infection in chicken spleen in response to NDV.
- IPA predicted increased glutamine synthesis in NDV challenged Fayoumi but increase cell apoptosis in NDV challenged Leghorn chickens at 2dpi, providing a clue for distinct resistance to NDV in the two inbred lines.

## Acknowledgements

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