# WAGENINGEN
## UNIVERSITY & RESEARCH

# Improving disease resistance in chickens: divergent selection on natural antibodies

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## Objectives
- **Divergently select layer chickens for total KLH-binding natural antibody titers**
- **Investigate correlated selection responses**
- **Investigate differences in *E. coli* disease resistance (proof-of-principle)**

## Conclusions
- **Selective breeding on KLH-binding natural antibodies is possible**
- **No (observed) negative correlated responses**
- **High line has increased *E. coli* disease resistance compared to Low line**

## Background
Natural antibodies (NAb) are antibodies present in individuals without previous exposure to the recognized antigen.
NAb binding Keyhole Limpet Hemocyanin (KLH) are:
 − heritable ($h^2 = 0.07$-$0.14$) (Berghof *et al.*, 2015, PLoS ONE).
 − associated with increased survival in layers (Star *et al.*, 2007, Poult Sci; Sun *et al.*, 2011, Poult Sci; Wondmeneh *et al.*, 2015, Poult Sci).
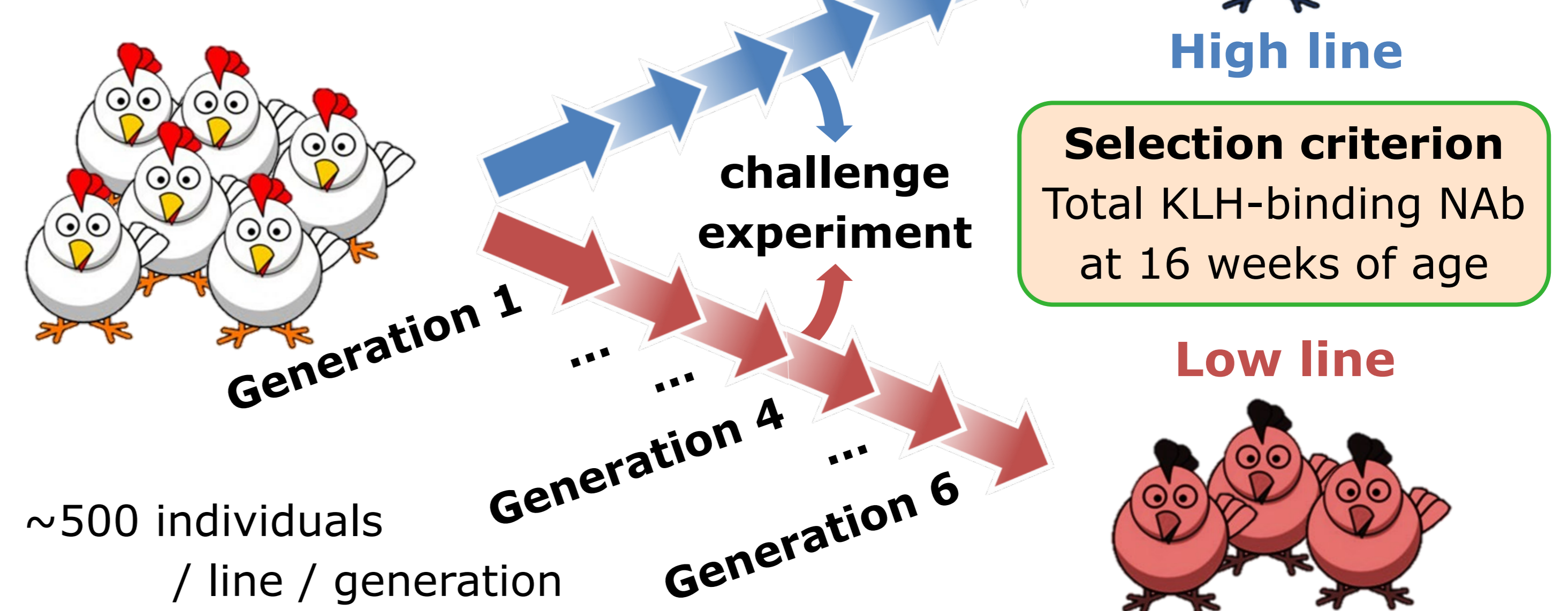
**A PhD thesis on a poster? Impossible!**
This work and a lot more you can find in my PhD thesis. Interested in a copy?
Send me an e-mail: tom.berghof@wur.nl

## Materials & Methods (Berghof *et al.*, 2018, Vaccine)
**Base population**
- Layer chickens
- ~3,700 individuals

High line

**Selection criterion**
Total KLH-binding NAb at 16 weeks of age

Low line

challenge experiment

Generation 1 ... ... Generation 4 ... Generation 6

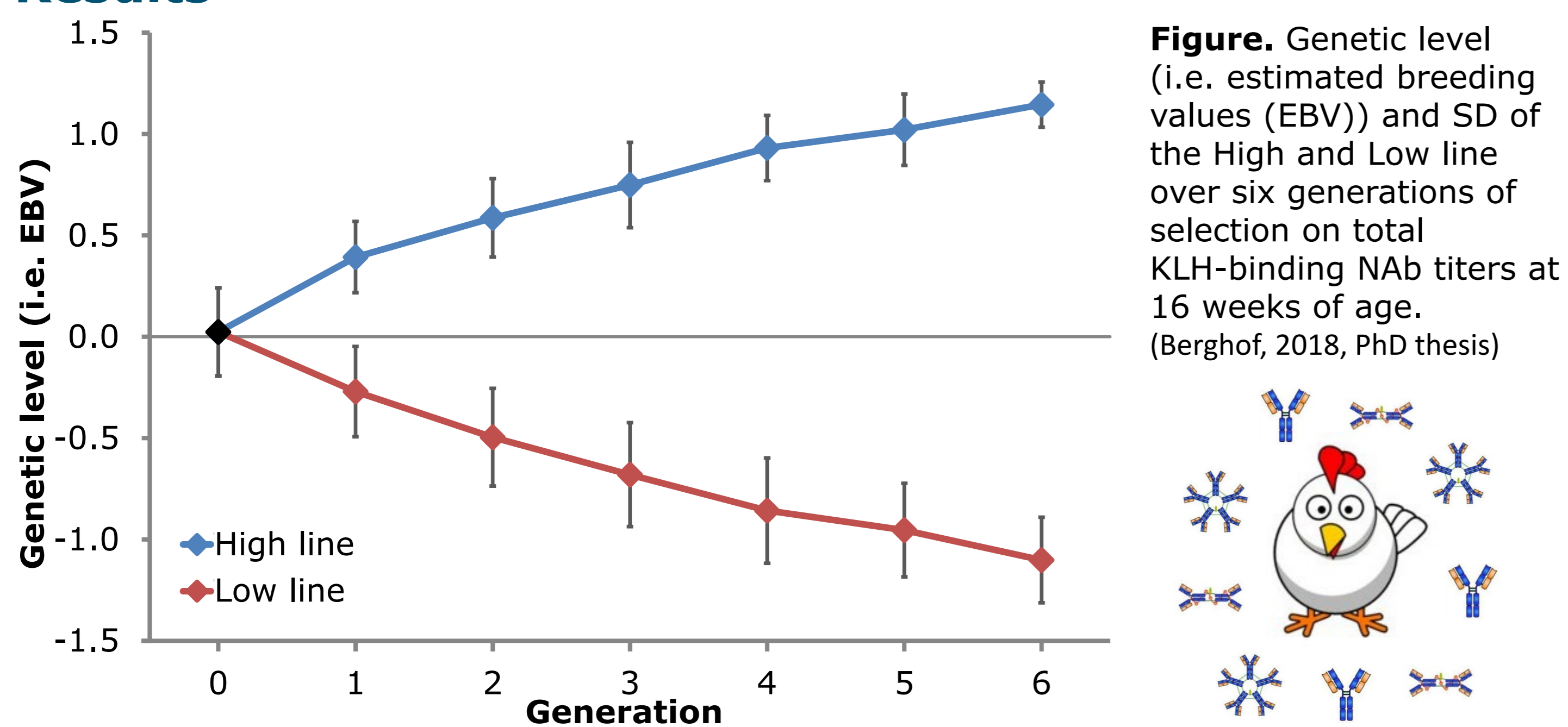~500 individuals / line / generation

## Results



**Figure.** Genetic level (i.e. estimated breeding values (EBV)) and SD of the High and Low line over six generations of selection on total KLH-binding NAb titers at 16 weeks of age. (Berghof, 2018, PhD thesis)
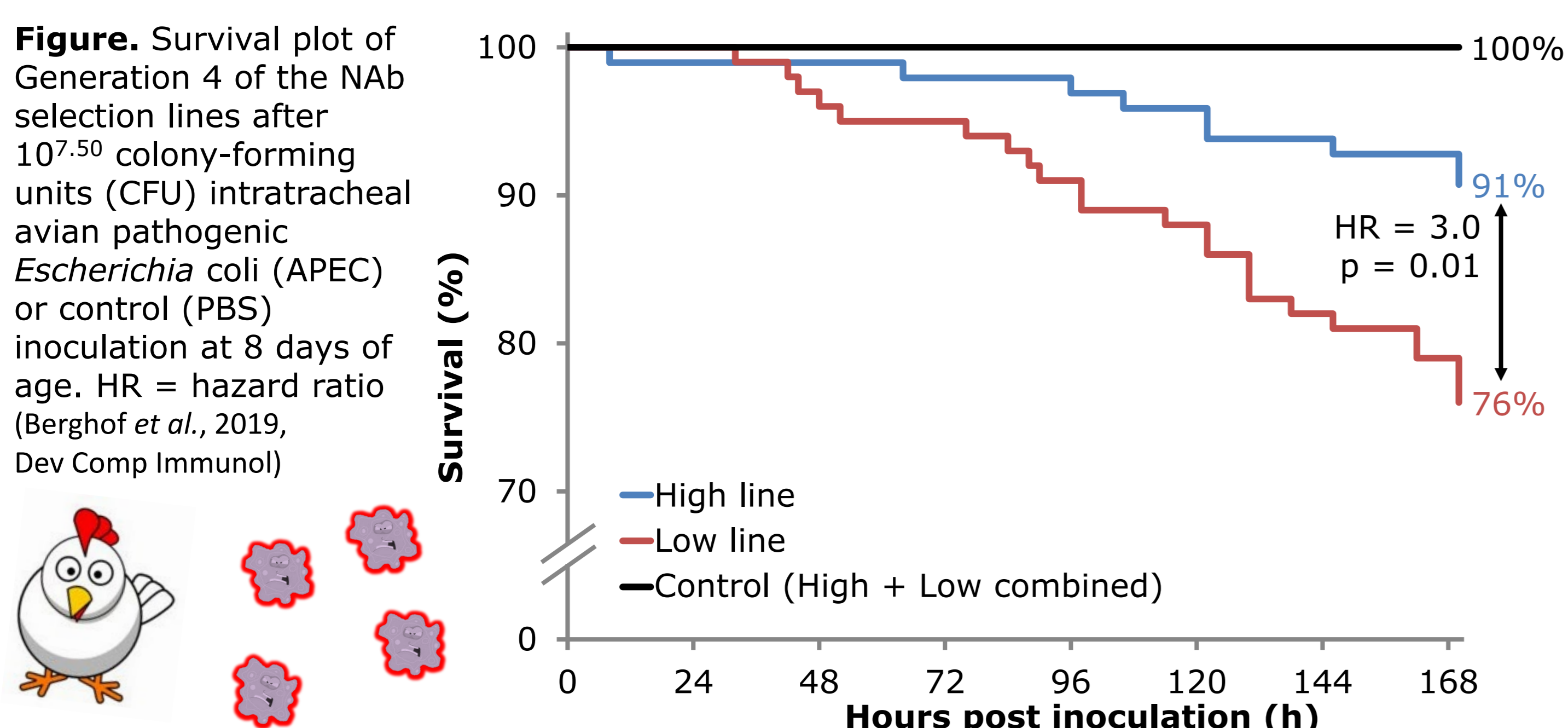
High line
Low line



**Figure.** Survival plot of Generation 4 of the NAb selection lines after $10^{7.50}$ colony-forming units (CFU) intratracheal avian pathogenic *Escherichia* coli (APEC) or control (PBS) inoculation at 8 days of age. HR = hazard ratio (Berghof *et al.*, 2019, Dev Comp Immunol)

100%
91%
76%
HR = 3.0
p = 0.01

High line
Low line
Control (High + Low combined)

**Table.** Correlated selection responses of divergent selection on total KLH-binding NAb titers (Berghof, 2018, PhD thesis).

| Trait | Age | Gen. | High vs. Low |
|---|---|---|---|
| KLH-binding IgM/IgG NAb | 16 weeks | 1-6 | > |
| *TLR1A* variant (Berghof *et al.*, 2018, Front Immunol) | High → dominant functional Low → recessive non-functional | | |
| (i.t.) *E. coli* resistance | 8-15 days | 4&6 | > |
| Several other NAb (Total/IgM/IgG) | 8-63 weeks | 2-6 | > |
| Total/IgM/IgG concentration | 20 weeks | 6 | > |
| % peripheral B-cells | 20 weeks | 6 | > |
| Bursa/Spleen weight | 15 days | 4&6 | > |
| HuSA-binding SpAb (Th$_2$?) (Berghof *et al.*, 2018, Vaccine) | ~35 weeks | 2 | > |

## Proposition
**KLH-binding IgM NAb represent B-cell development, thereby it is a proxy for humoral baseline immunity. Thus, it shows the potential of the humoral immune system.**
(Berghof, 2018, PhD thesis)