

Alternatives for killing day-old male chicks

Symposium September 8, 2014

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Aim of this presentation

- Today's symposium: Research on:
 - Alternatives for the killing of day-old chicks
 - Societal and ethical aspects thereof.
- The occasion:
 - Promotion of dr. Aamir Aslam this morning
 - His studies are relevant for two proposed alternatives for the killing of day-old chicks.
- We addressed other potential solutions in other projects.
- In this presentation I would like to give an overview of the research done at Wageningen UR Livestock Research.

Problem and Background

- Males of layer breed not suitable for meat production
- 45 million male day-old chicks killed per year
- Report Woelders et al 2007: Ten potential solutions
Plus ethical framework.

Opinion of general public

- Only societally acceptable solutions are worthwhile.
- Therefore:
First measured societal acceptance and ethical arguments.
- Focus groups → Qualitative results: ideas and motives
- Public survey → Quantitative results

Overall ranking

1. Sexing eggs before incubation 25%
2. Dual purpose chicken 24%
3. Hens lay fewer male eggs by natural mechanisms 14%
4. Accept current practice of killing chicks 14%
5. Sexing eggs before incubation, using G.M. 10%
6. Sex reversal, using G.M.
7. Breed chickens to select for lethal male embryos
8. Sex late developing embryos, then kill the male eggs
9. Sex early developing embryos, then kill the male eggs
10. Use G.M. to get lethal male embryos

Market/societal solutions

Market/societal solutions

- Accept killing of young animals, if utilized?
 - Killed on day 1:
 - 93% frozen day-old chicks are used in some form. (Only NL)
 - 50% as feed for zoos.
 - Raise to 10 weeks (1kg), then slaughtered. Better?
 - Niche market for 10 wk chicks is possible.
 - But bigger footprint (animal feed/land use/energy/ waste)
- Dual purpose chicken?
 - Less attractive solution
 - More loss of resources / even bigger footprint



GM chicken to enable sexing eggs

GM chicken to enable sexing eggs

- Gene for green fluorescent protein can be inserted in Z chromosome. Proven technique!

- To produce fertile eggs for the layer industry, cross:

Z*W female x ZZ male

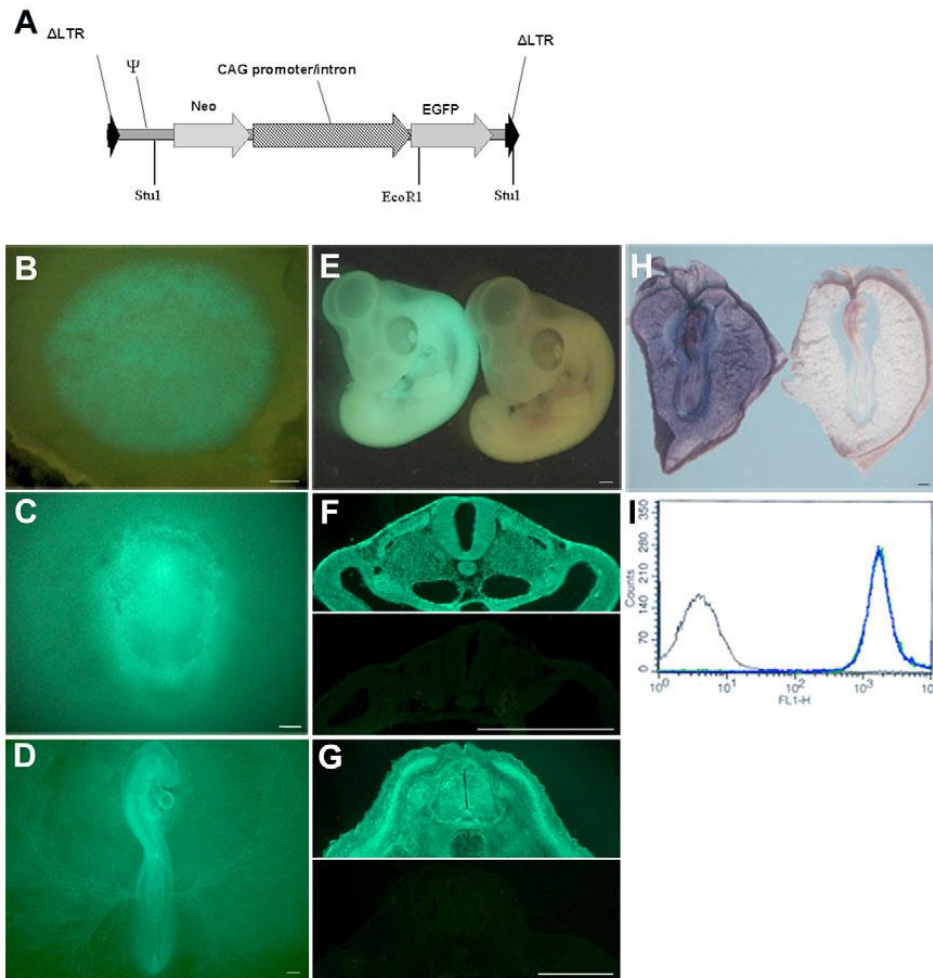
→ Z*Z or ZW eggs

- Male eggs will carry the transgene. → fluorescence in the blastodisc → male eggs selected out.
- Female eggs do not carry the transgene. These will be incubated to become the future layer hens.
- → The layer hens and the consumption eggs are not GM.



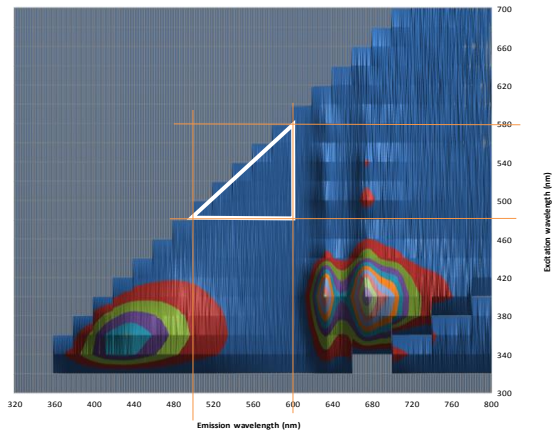
Can we measure the fluorescence from intact eggs?

- Blastodiscs of unincubated eggs contain \pm 5000 cells
- Expression of embryonic genome starts before egg is laid.

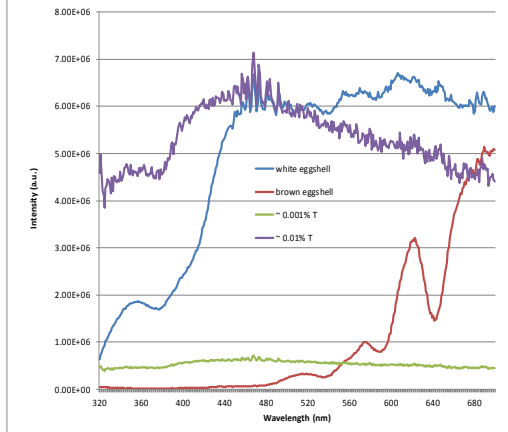


Can we measure the fluorescence from intact eggs?

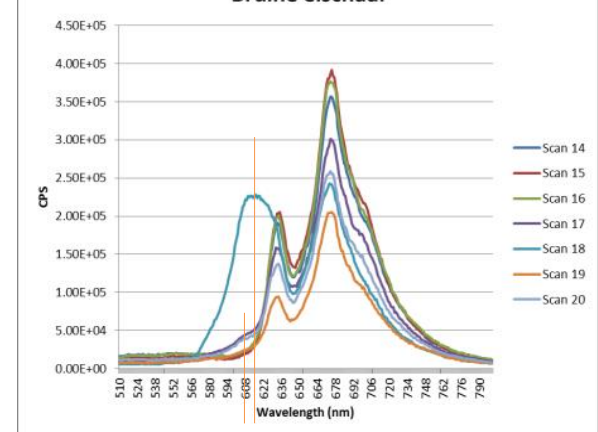
fluorescence eggshell (white egg, fiber)



Transmission eggshell (wavelength dependency)

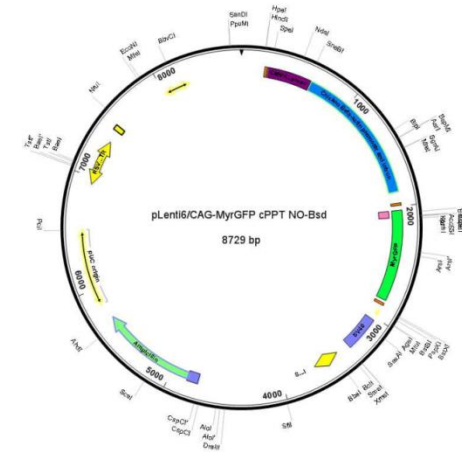


Bruine eischaal



Conclusion: Yes we can

Making transgenic chicken ?



- Demonstration project?
To be used in ethical debate in society and government
- Working together with CBD, weighing all alternatives.
 - Positive advice in 2011 and in 2012.
 - But no political/public support → No go

Alternatives addressed in thesis dr. Aslam

- In ovo sexing of unincubated eggs
- Influence the hens to lay more female eggs

In ovo sexing eggs before incubation

- Most ideal:
 - Eggs are still just eggs; No differentiated embryo.
 - Male eggs can be used for egg products. Female eggs can be incubated to give female chicks.

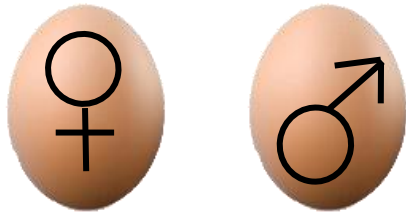
- Can we sex eggs before incubation (without G.M.)?
- Are 'male' eggs and 'female' eggs different in any aspect?
 - Indications reported in Literature!

Sexing eggs before incubation

- “Golden standard”: Sex eggs in the laboratory
- We developed a method for sexing unincubated eggs by PCR
- This technique was used in all further studies.



Search for differences male-female eggs

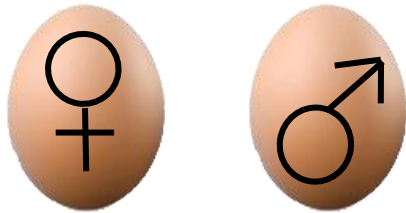


Egg dimensions (mass, length, width)

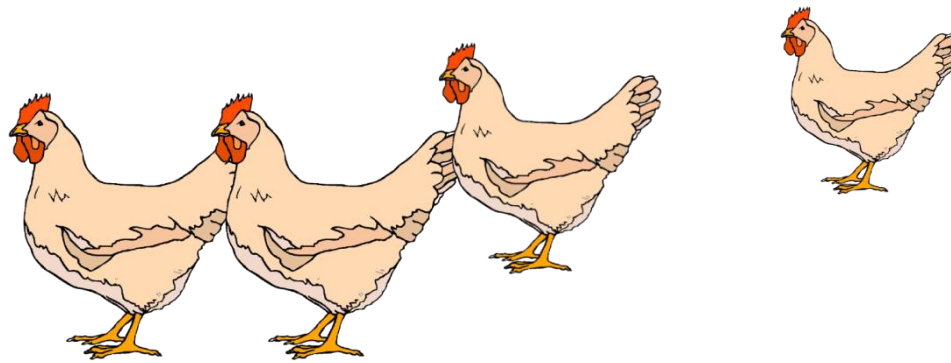
Sample the yolk

- Glucose
- Hormones
 - Estradiol
 - Testosterone
 - Progesterone
 - Androstenedion
 - Dihydrotestosterone

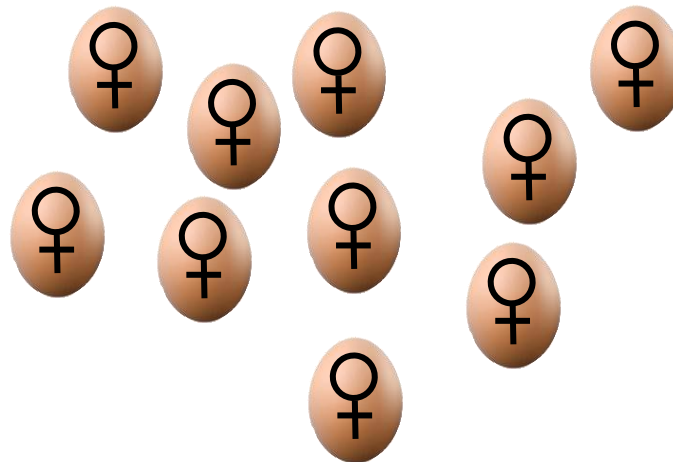
Search for differences male-female eggs



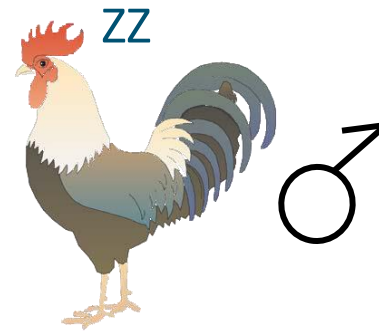
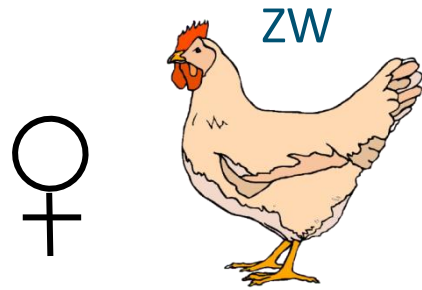
- No differences found that could be used for sexing the eggs
- Difference with other studies may be explained by artefacts introduced in the earlier studies by sampling incubated eggs.



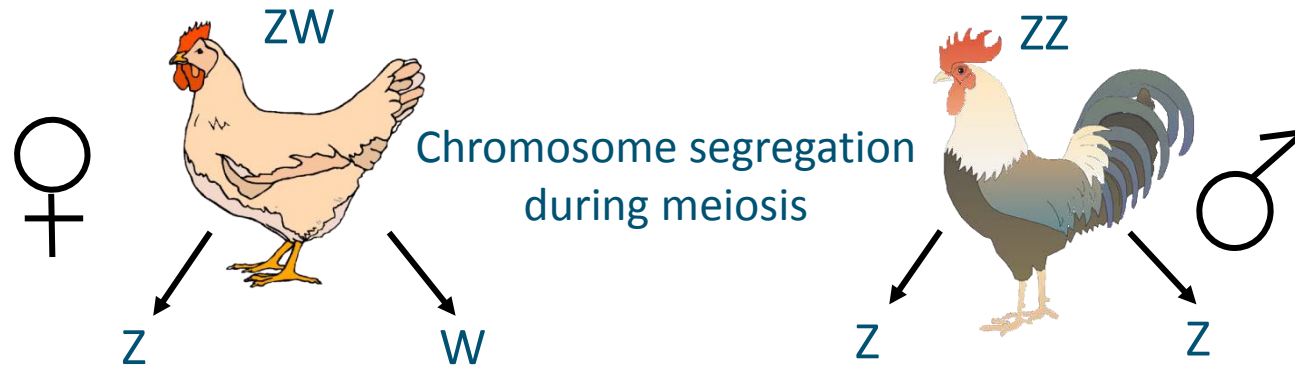
Influence the hens to lay more female eggs



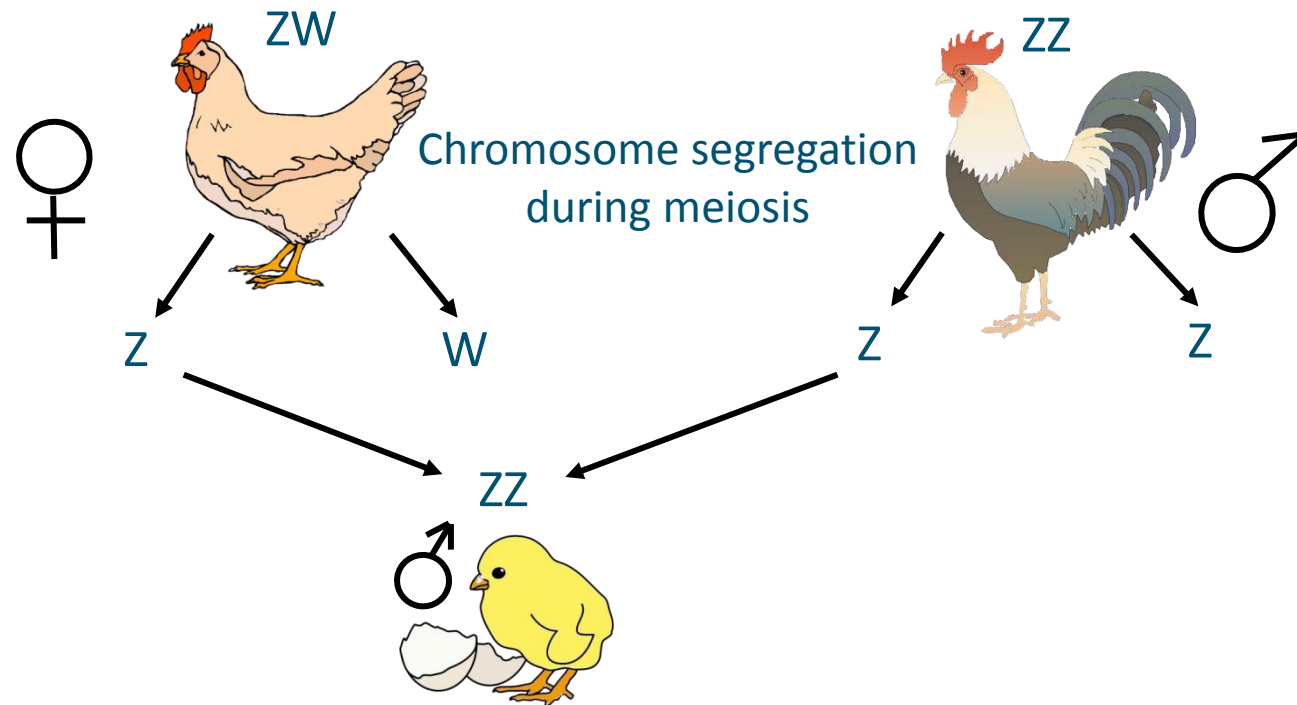
Sex determination in chicken



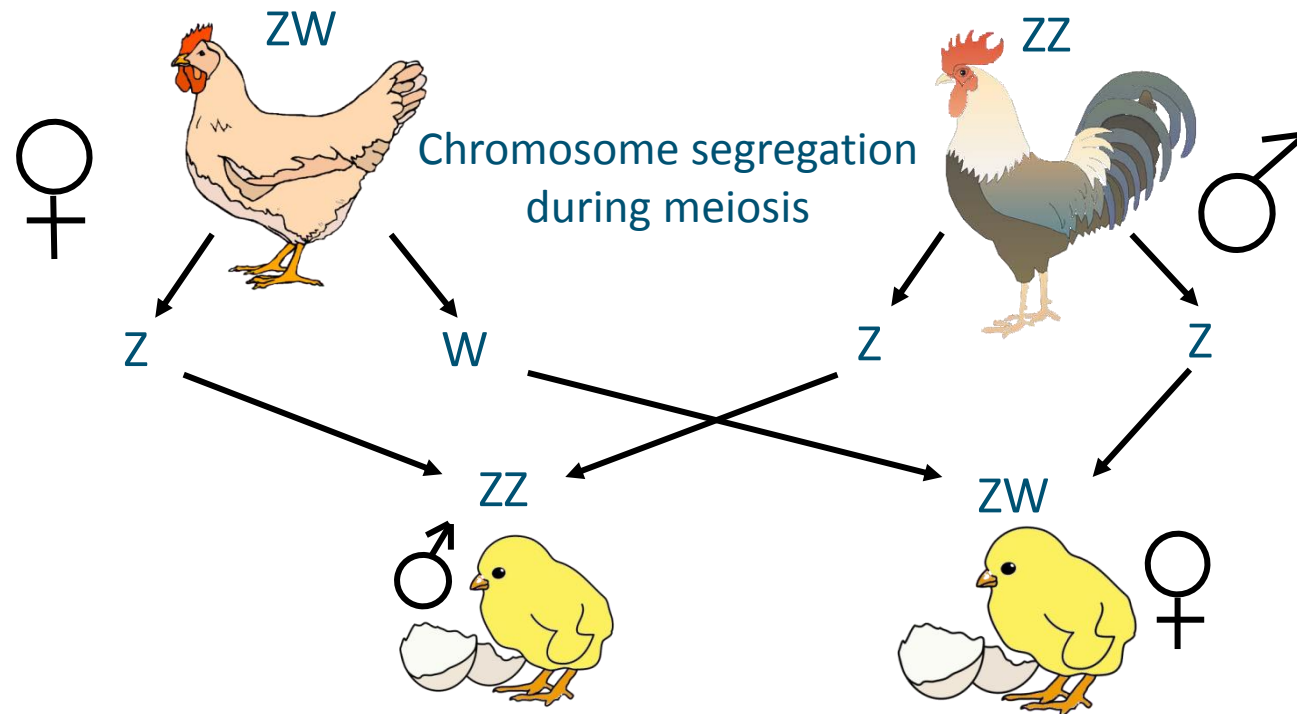
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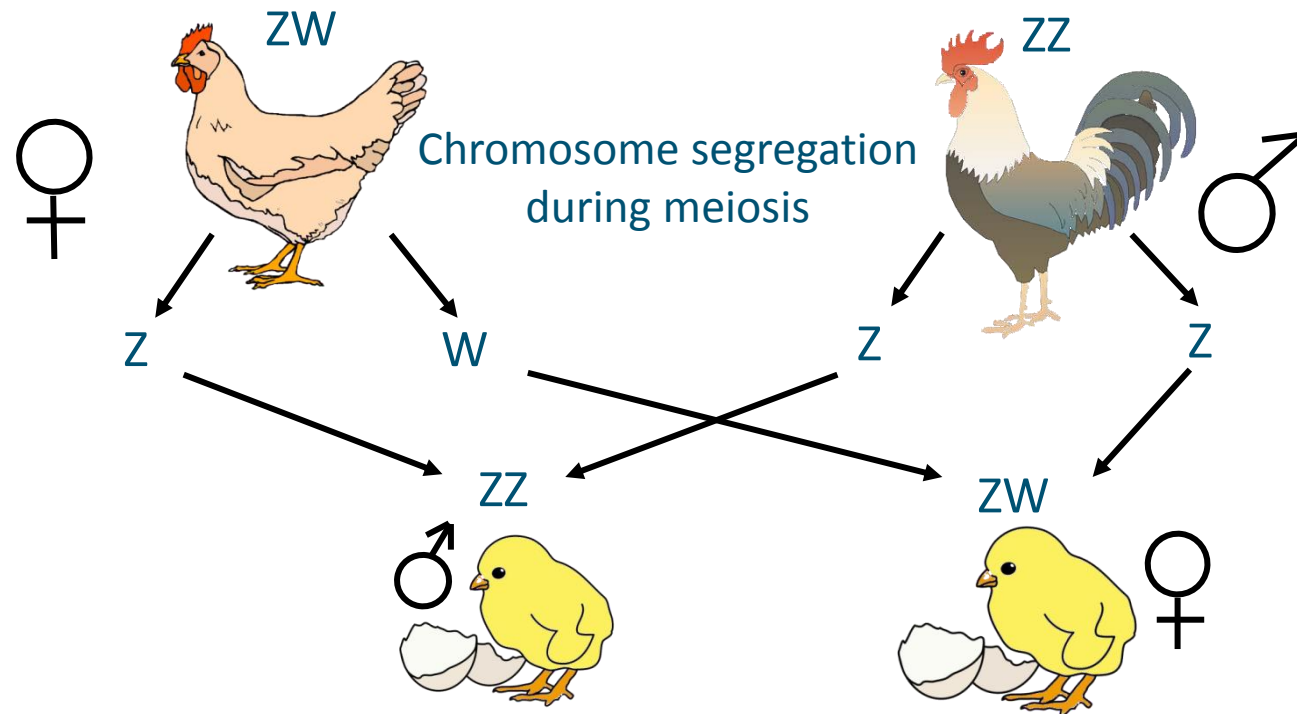
Sex determination in chicken



Sex determination in chicken



Sex determination in chicken



→ Sex of chick is determined in the hen before the egg is laid!

Can we induce female sex ratio bias?

Two treatments were studied:

1. Corticosterone (in feed)
2. Feed restriction
 - Elevated blood levels of corticosterone.
 - Negative energy balance.
 - Decreased hen body mass and egg mass.

Corticosterone feeding

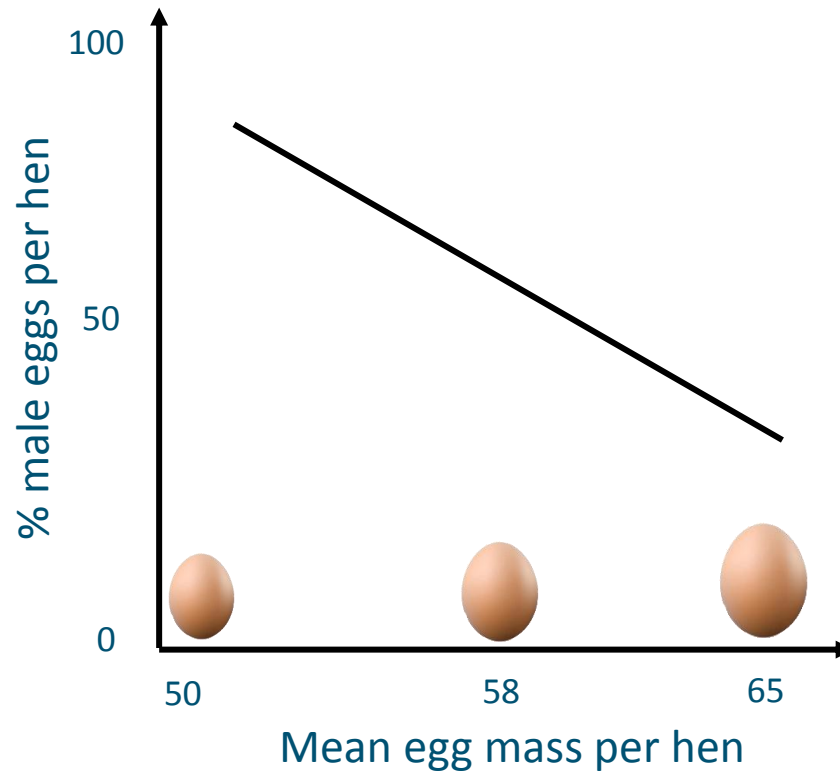
- Elevated corticosterone levels in blood
- In heavy hens, cort feeding lead to:
 - Lower sex ratio (fewer male eggs)
 - Lower laying rate
 - Lower fertility of the eggs
- In light hens no effect or the opposite effect

First feed restriction experiment

- Significant decrease sex ratio over time
- Rate of decrease of hen body mass around the time of meiosis predicted the sex of the respective egg.
- Relation with corticosterone:
 - Increased cort levels in blood
 - Cort level was negatively correlated with laying rate and sex ratio per hen

Second feed restriction experiment

Negative correlation between mean egg mass per hen and sex ratio



Second feed restriction experiment

Genome-wide gene expression (micro arrays):

- 8 hens with male sex ratio bias
 - 8 hens with female sex ratio bias.
- Hens were sacrificed at the end of feed restriction treatment
 - In the night: around time of meiosis.
 - Preovulatory follicles were harvested
 - RNA was isolated from blastodiscs
 - Gene set enrichment study:
Gene sets related to cell cycle / mitosis / meiosis had higher expression in hens with female sex ratio bias.

Conclusions

- Sexing of unincubated eggs is not an option
- Laying hens can change sex ratio → fewer male eggs
- Three independent pieces of evidence suggest that the mechanism of sex ratio bias is 'Meiotic drive' in the ovary.
- Present treatments are only for experimental purposes.
- We should first find ways to switch on the mechanism in an animal-friendly way before sex ratio change can be considered.



Current state of the research

- Dual purpose chicken/raise male chicks
 - only feasible for niche market
 - no solution for overall poultry production
 - Less sustainable: Larger footprint
- Sexing egg using genetically modified chicken
 - Is technically feasible! But currently not accepted
- Sexing unincubated eggs (without G.M.): Not feasible
- Influence the hen to lay more female eggs
 - Sex ratio can be influenced
 - But practical application is uncertain and lays far ahead

Thank you for your
attention

