



Alternative to the culling of male day-old chicks of layer lines

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The specialized chicken lines



Layer hens

(340 eggs per year)
Meat is not marketable



ZW female chicken



~~ZZ male chicken~~

Broiler Production

(<150 eggs per year)
Non marketable low
quality eggs



6 billions of males are killed every year in the world



Ethical and societal concern



Alternatives ?

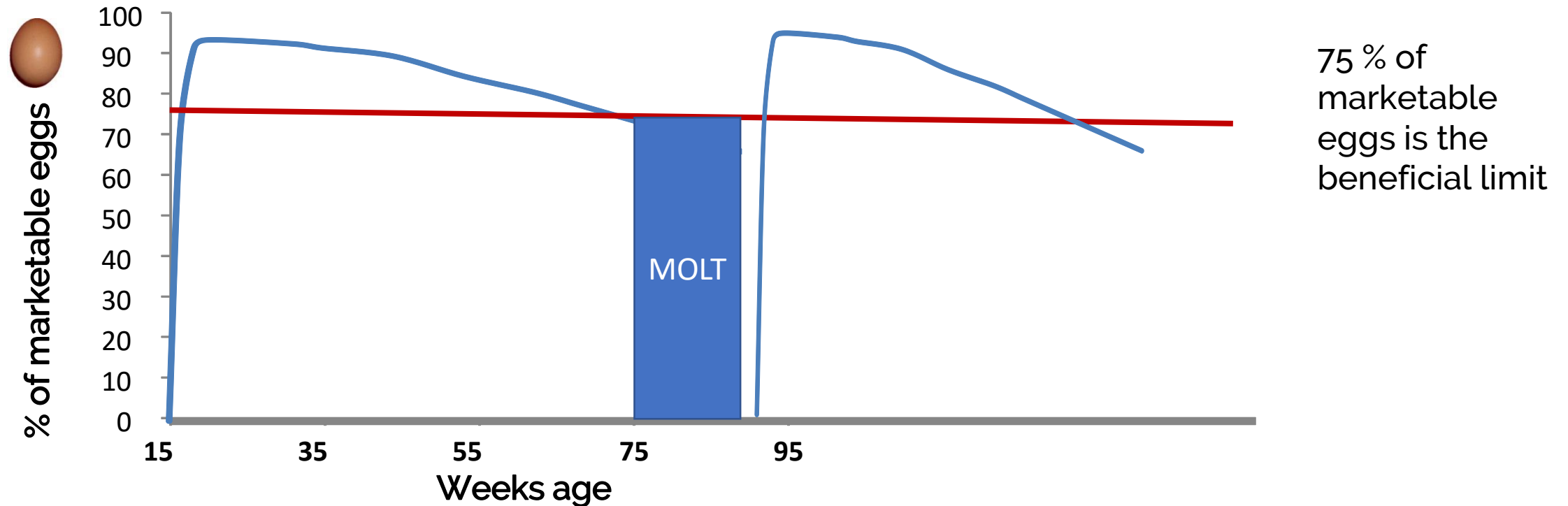
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13/01/2020 / German-French seminar/ Joël GAUTRON

Reduce the number of layers

✓ Use of molt cycles



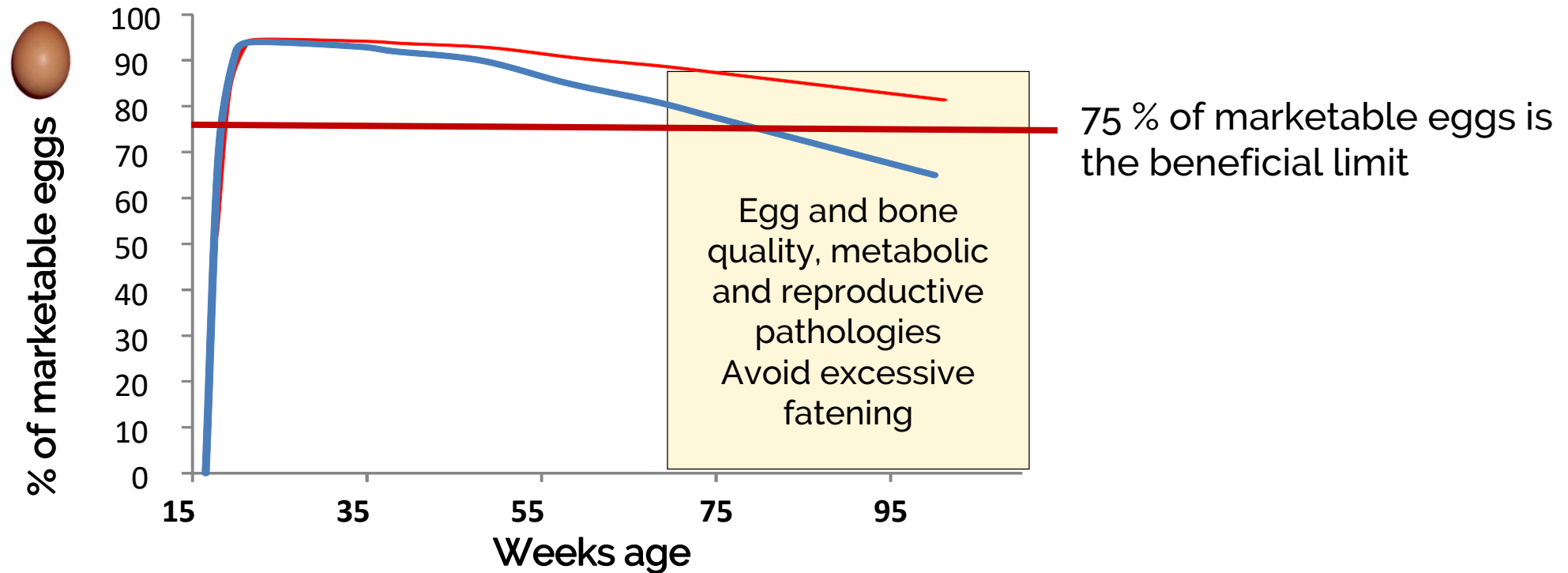
Second and third laying cycles are possible after molting of the layer

→ Need to induce artificial molt with water and feeding privation not allowed in EU

Research is needed to induce moulting while respecting animal welfare

Increasing persistency of laying hens to reduce the number of layers

Breeding companies claim that they will have developed the « long life » layer, which will be capable of producing 500 eggs in a production cycle lasting 100 weeks by 2020 (Van Sambeek, 2010)

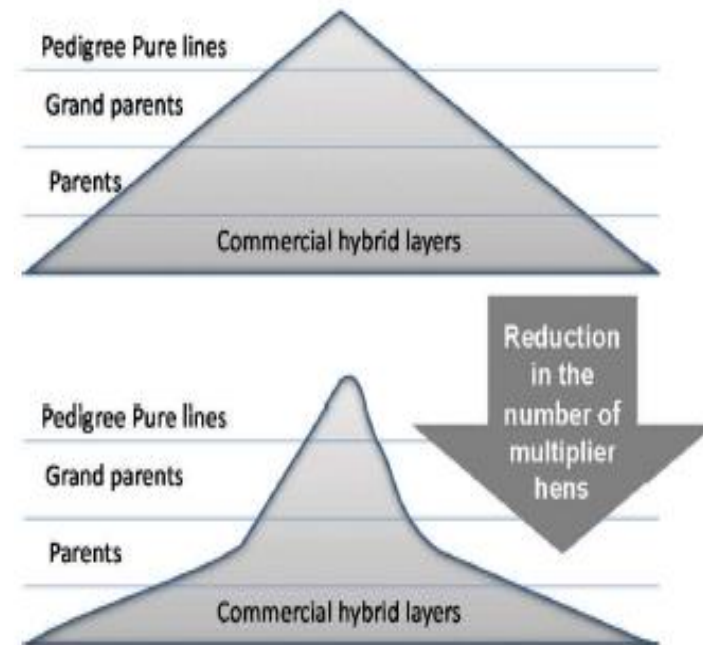


Increasing persistency of laying hens to reduce the number of layers

Bain et al., 2016 estimated « than even 25 more eggs per hen could potentially reduce the UK flock, including breeding hens by 2,5 millions birds per annum. »

limited by the health charter in France...

Reduce, but don't avoid the culling of male day-old chicks of layer lines



PPILOW European project



INRAE
science for people, life & earth

Coordinator A. Collin
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Poultry and Pig Low-input and Organic production systems' Welfare

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 816172

WP 5 Innovative alternatives of the elimination of one day old male layer chicks

1. Task 5.1: Evaluation of dual-purpose production potential in different environment (month 1 to month 50)
2. Task 5.2: Evaluation of dual-purpose genotypes on organic farms (month 24 to month 60)
3. Task 5.3: Early sex determination using *in-ovo* methods (month 1 to month 54)

Dual purpose chickens



Layers strain

(340 eggs per year)
Meat is not marketable



Broiler strains

(<150 eggs per year)
Non marketable low
quality eggs



Crossbreed

Females are reared
for egg production

Males are reared for
meat production

Low number of eggs
Quality ?

Unfavorable
environmental impact

Low meat yield
Different meat texture (consumer
education)

Need to evaluate the productivity, the quality, the behaviour of animals in various housing systems and various environmental conditions, health and costs

IN OVO SEXING

Gender determination before the birth

- ✓ Must be fast (20 000 to 30 000 eggs per hour)
- ✓ Must be cheap
- ✓ Must be precise (98.5 %)
- ✓ Without detrimental consequences on the hatchability and the viability of the chicken
- ✓ Must be done before 9 days of embryonic development to avoid any nociception

→ A frantic race between states, scientists and industry to offer alternative solutions and hit the jackpot.



How to determine sex in ovo

- Destructives and non destructive methods
- Biological approaches
 - Hormonal detection
 - Metabolite marker detection
- Physicochemistry approaches
 - Dimorphic volatile odors between male and females
- Physical and optical approaches
 - FTIR spectroscopy
 - Raman spectroscopy
 - Magnetic resonance imaging
 - Hyperspectral analysis
- Genetic engineering
 - Genome editing



How to determine sex in ovo

Project	Country	Method	Day of egg incubation	Accuracy %	Price Cents/egg	Number of egg / H	Marketing	Remarks
SELEGGT	Germany	Hormonal	9	97-98	1-3	5000	Yes	The only available commercial solution, but not enough fast for the entire egg market
EMBREX	USA	Hormonal	17	100 ?	???	???	No	No prototype, 17 days is too late
In ovo	Netherlands	Metabolite	9	??	???	???	Planned in 2020	2 Sec/egg
Vital farms	USA	Odor detection	???	???	???	???	???	
EggXYt	ISRAEL	Genome editing	0	100	???	A lot	Yes	Transgenic chickens, consumer acceptance
Dresden	Germany	Raman	3,5	90	???	???	Prototype	Accuracy to improve
Hypereye	Canada	Hyperspectral	0	99	1-5	30 000 50 000	????	Large number of eggs, No news since 2018
Evonta	Germany	Hyperspectral Feather color	14	97	???	???	???	Late determination, Needs strains with feather differences
SOO	France	Raman Biocaptors	???	???	???	???	???	
PPILLOW	France	Electromagnetic signature	???	???	???	???	No	

Many of them are still in development

Research and development must be continued (New methods, Big data, deep learning, artificial intelligence)



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(2019-2024)

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(INRAE Egg team UMR BOA, LAAS CNRS, OVALIE Innovation)

- Development of physical methods based on electromagnetic signatures of males and females
(Non-invasive method)
- Characterization of omics signatures in allantoic fluids of male and female embryos
(Identification of new biomarkers or a set of complementary biomarkers)

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Take-home messages

Few alternatives to the culling of male day-old chicks of layer lines:

- **Increasing of laying period and use of molt cycles to reduce the number of births chickens for renewal**
- **Developing dual purpose chickens, but not for a mass market**
- **Strengthening the development of *in ovo* sexing processes**

BUT

- **Today whatever method used, no fast and robust method is operational**
- **A race against time: There is an increased need for research and development before considering the industrial scale**
- **This change will be really challenging for producers with many technical and economical adaptations**

