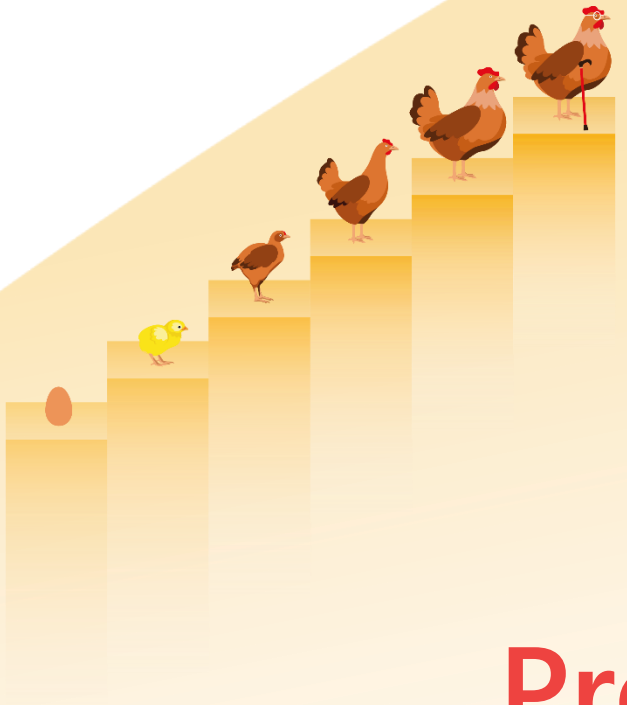


Préparer la ponte dès la poulette: croissance, os et qualité de l'oeuf

Evelyne DELEZIE

Chercheuse sénior et responsable du groupe volaille

ILVO- Belgique

REARING PERIOD IMPORTANT. Why?

- Last 50 years: extended laying cycle

  from 68 wks to 80-85 wks laying period

- **Past**: 350-360 eggs / laying hen

Efficient turnover of nutrients
= metabolic challenge

Nowadays,

500 eggs,
100 wks of age,
without moulting

STRESS

REARING: PULLETS → Laying hens

FACING CHALLENGES:

1. **Hatchery- Rearing farms**
   1. Dehydration first days (transport, housing)

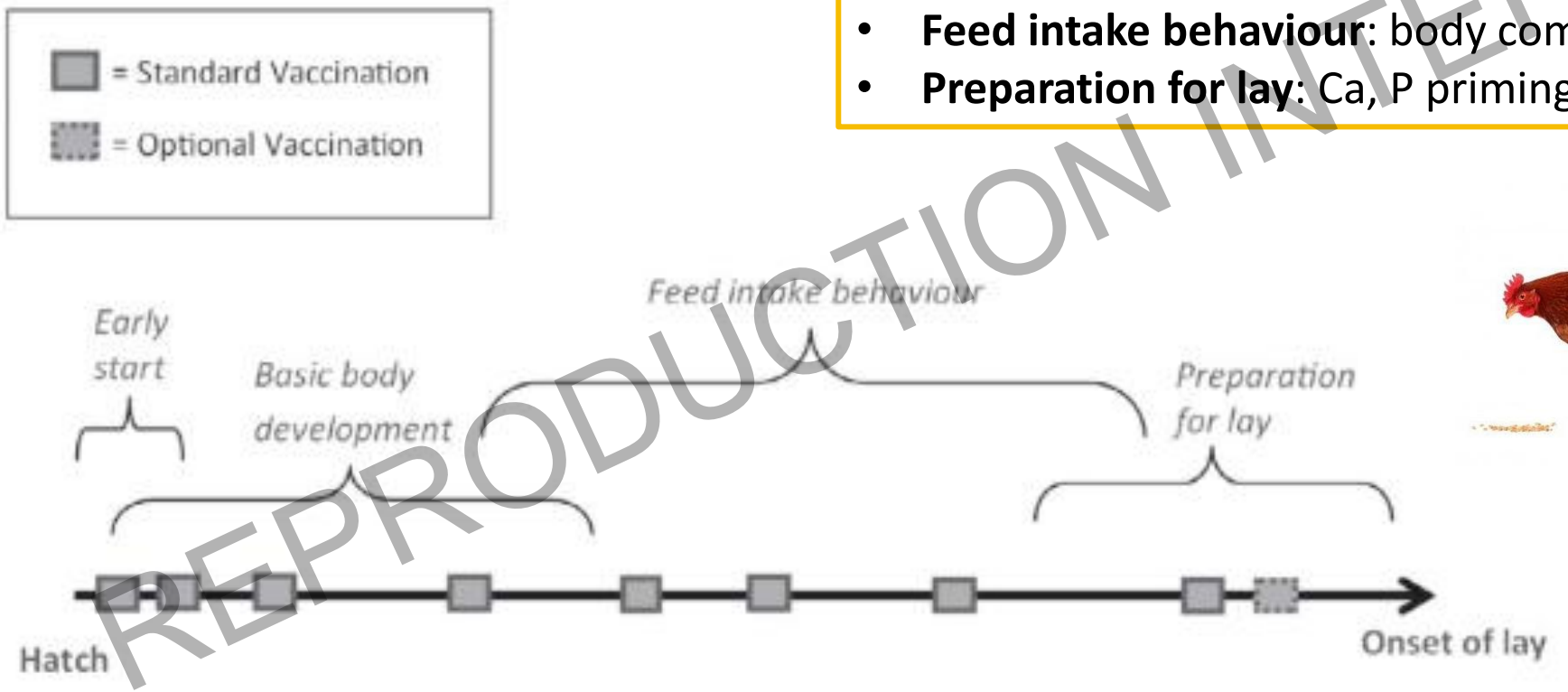
1. **Numerous vaccinations (stress)**
   1. Reduced appetite: feed intake capacity
   2. Retarded growth
   3. Uniformity : individually fed vs flock as a whole

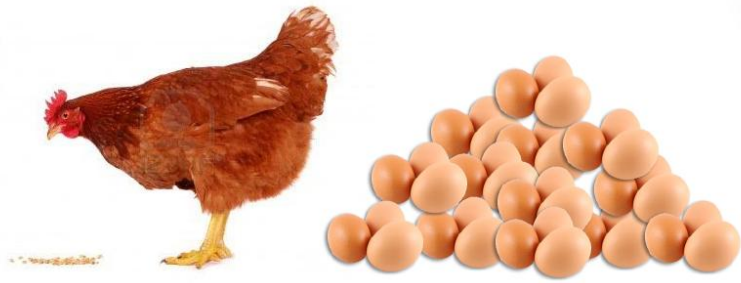
3. **Transfer to the layer house**
   3. Transport, diet changes (form, ingredients, nutrients)

4. **Physiological changes: Bodyweight / development**

Time schedule (cascade events) from hatch to 18wks of age

- **Early start**: Wet feeding?
- **Basic body development**: Critical growth phases
- **Feed intake behaviour**: body composition, performance, FP
- **Preparation for lay**: Ca, P priming





Knowlegde GAPS but few articles published

Kwakkel et al., 2021

Pullet nutrition

Towards a 100 wk production

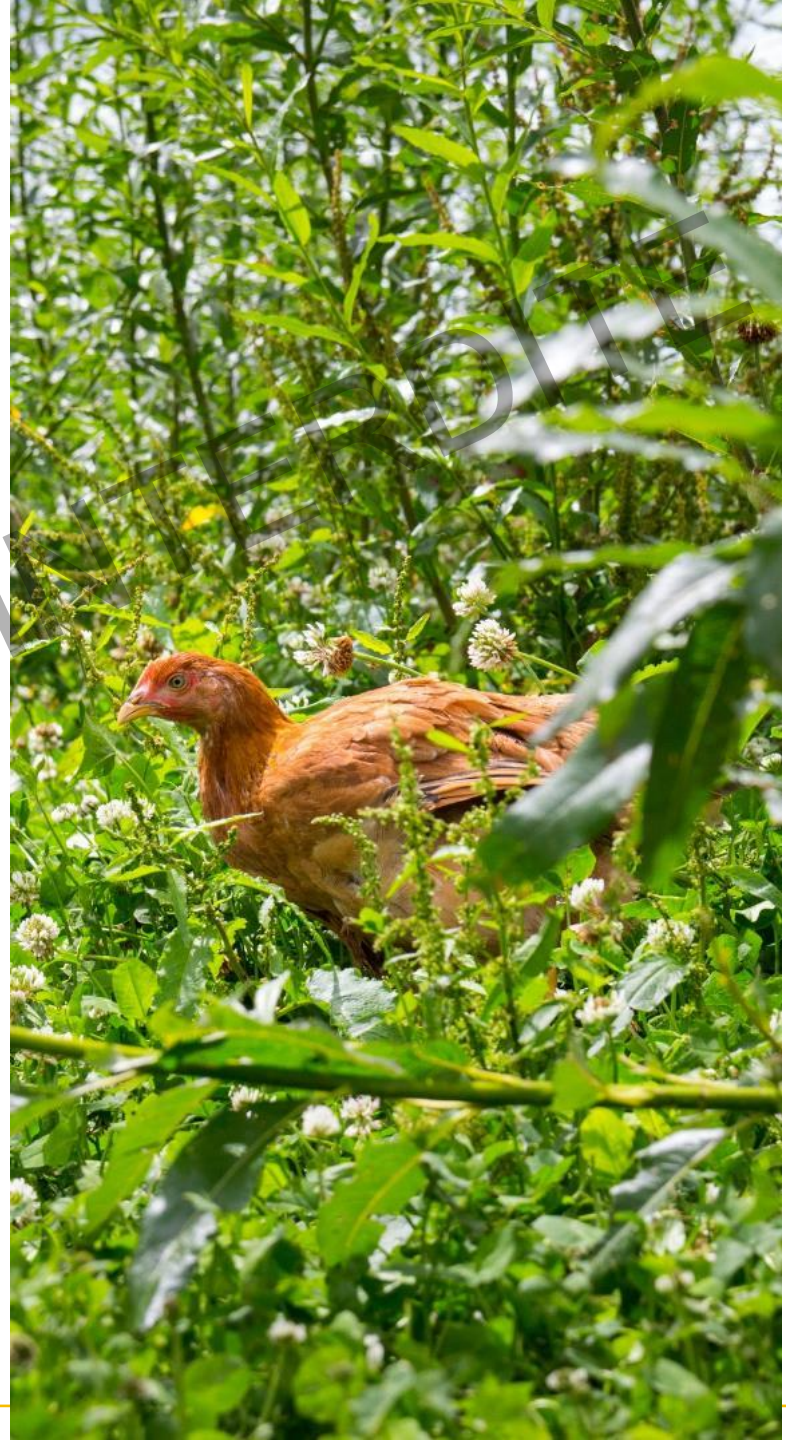
Allometric Growth

Bone Development

Gut Health

Behaviour

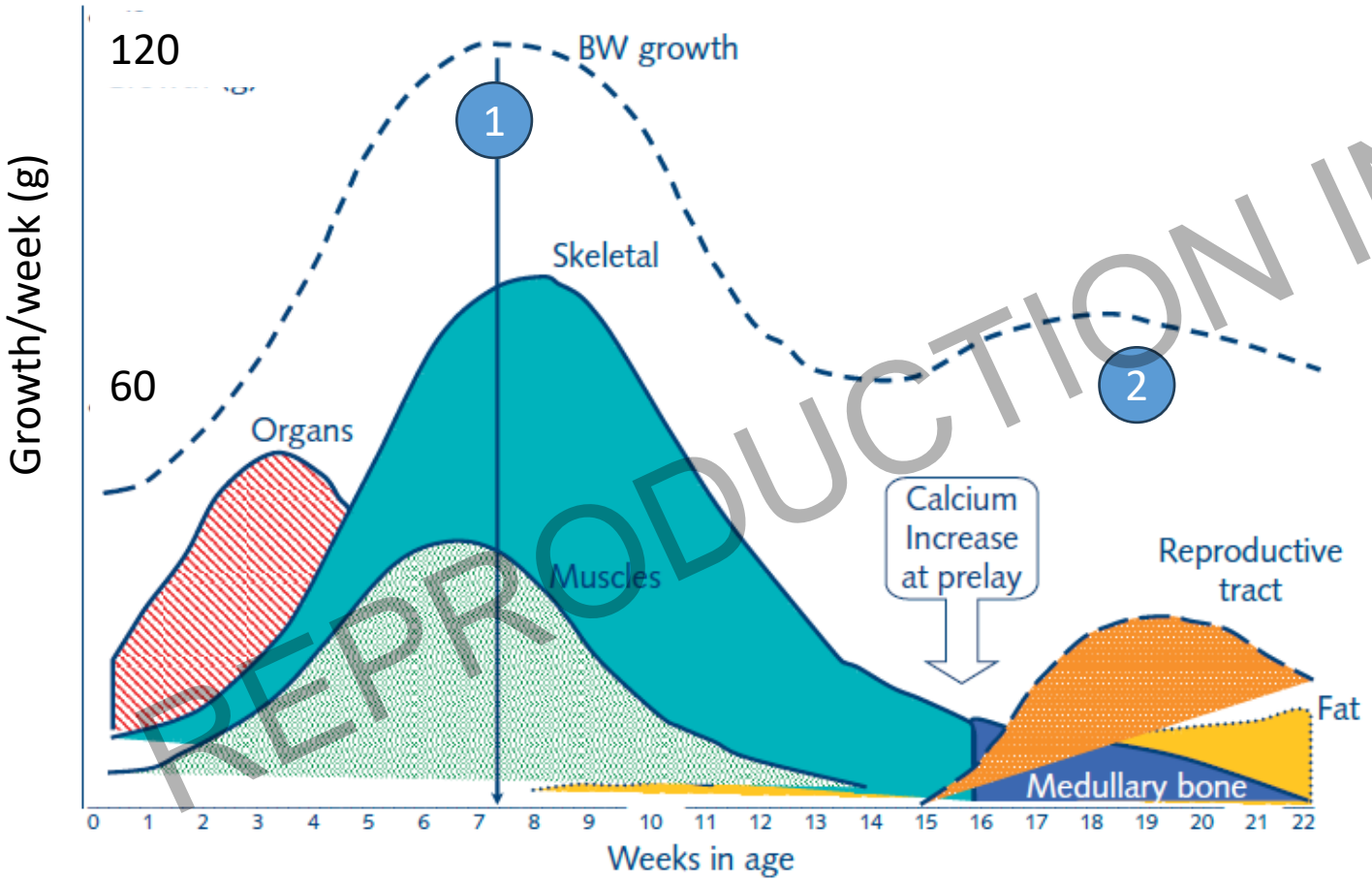
1. Allometric Growth



A challenging start…

First week of life:
- Maturation of thermoregulatory system
- Maturation of the immune system
- Maturation of the GIT

Simon et al., 2015

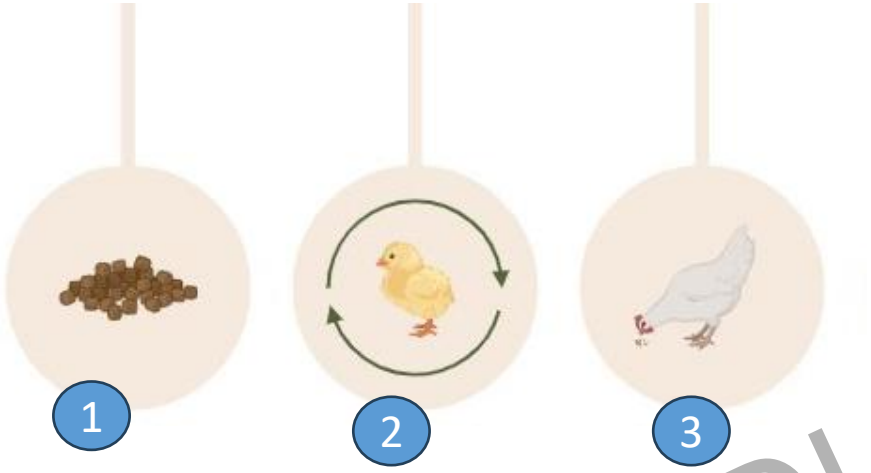


1 Basic body development

2 Reproduction

Kwakkel et al., 1994-1997

Diet density… on body development



3 nutrient densities: Low, medium, high

White pullets
0-17w: density diets
18-35w: Standard diet

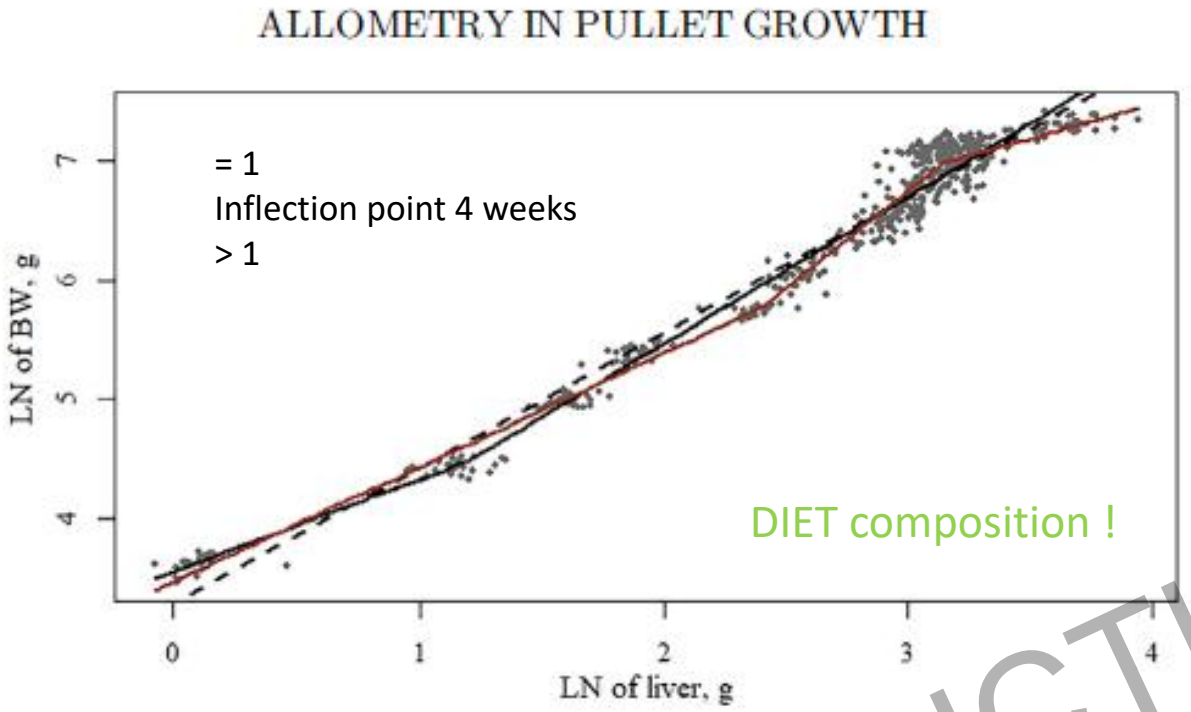
Performance, body comp. development, egg production

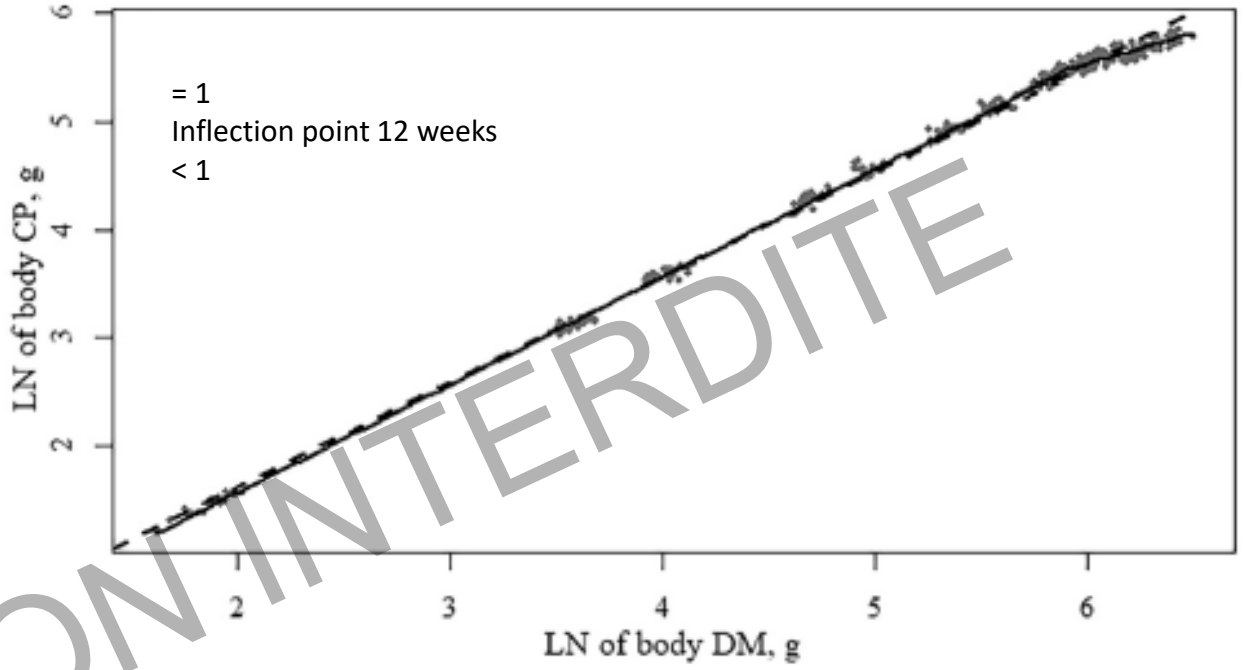
1. **Body weight**:

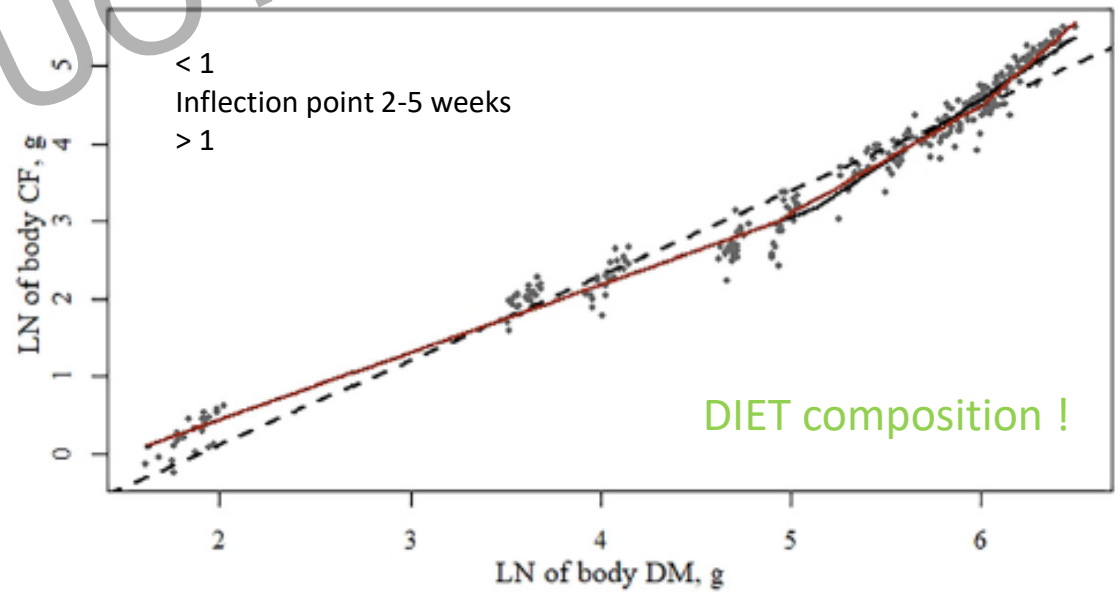
   Target body weight end rearing phase : Higher egg mass production

1. **Body composition:**
   1. **CP**: muscle, essential tissues and organs
   2. **CAsh**: skeletal structures
   3. **CFat**: Adipose tissue (maintaining body energy balance , reserve if nutrient uptake is not sufficient) (peak)

Van Eck et al., 2024







COQU'idées
POUR LE BIEN DES PONDEUSES

Van Eck et al., 2024

Effect diet density during rearing until 35 wk

	BW	Composition	Egg quality	FCR
High density diet	Linear increase	Higher fat , Equal protein deposition	Not affected	Not affected
	Differences until 35 wk	Differences until 35 wk		

Changes in diet density affect body CF deposition more than body CP deposition, from an early age onward. New model!

Optimal (early) body development

- Basic body development occurs allometrically
- An adequate basic body development up to 10 weeks of age should be guaranteed

Advice: FOCUS Pullet REARING

- No nutritional restrictions before 10 weeks: feed intake drives performance
- Follow-up body weight !

2. Bone development

BONES as Ca Source

Whitehead, 2004

Bone classification

Cortical Trabecular Medullary

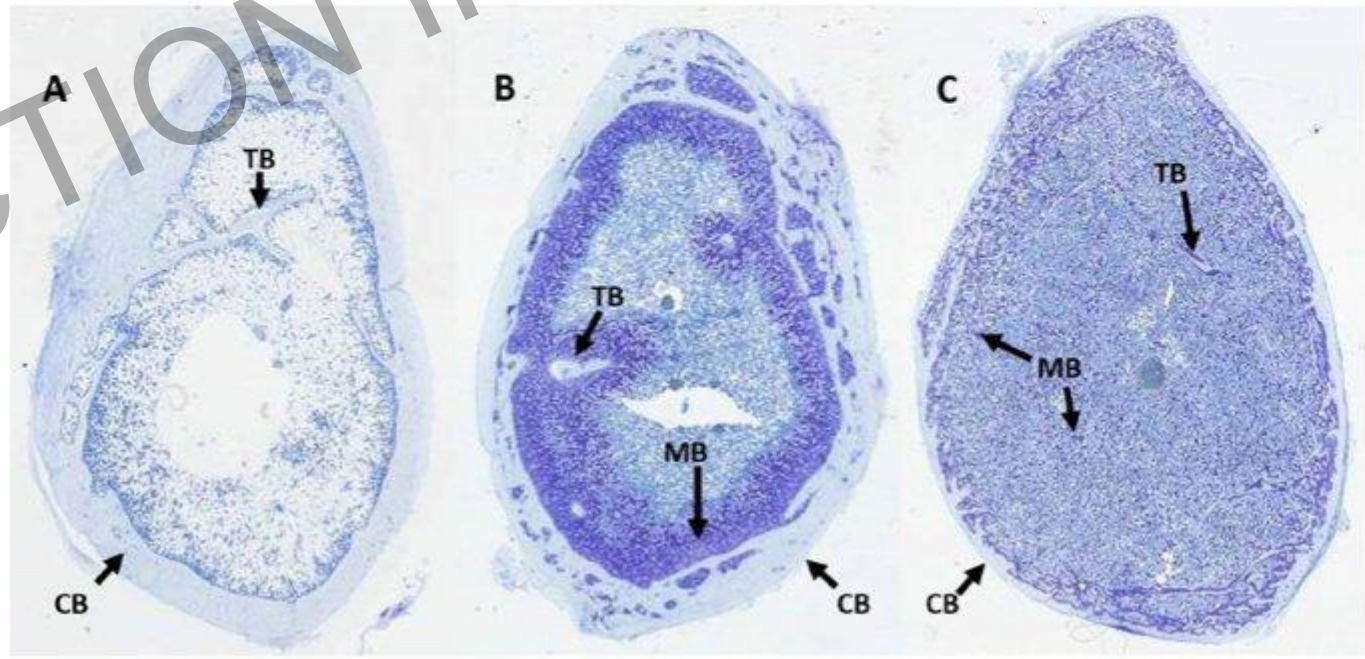
- Fast Ca-source
- Important for Ca supply during the night
- MB deposition starts 10 after first egg

Figure 1 – Cross-sections of tibiae from laying hens of various ages. CB = cortical bone; TB = trabecular bone; MB = medullary bone.

A) Layer pullet (16 weeks of age) containing only the cortical shell and trabecular struts. Diffuse staining within the cortical shell is an artifact. Structural bone (CB + TB) tissue shows very little in the way of pore formation at this level of magnification. Sexual immaturity was confirmed at time of sampling by the absence of ovary development.

B) Laying hen after the first egg was laid, showing the cortical shell, trabecular struts, and medullary bone. The medullary bone is present as small spicules of bone tissue, initially deposited on the surfaces of the structural bone tissues. Pores containing medullary bone within the cortical shell are clearly visible.

C) End of lay (67-week old) hen showing depletion of cortical and trabecular bone tissues, and diffuse nature of medullary bone throughout the medullary cavity. MB arrows point to some larger spicules of medullary bone.



16 weeks 1st egg End of lay

Ca: key role

Importance:

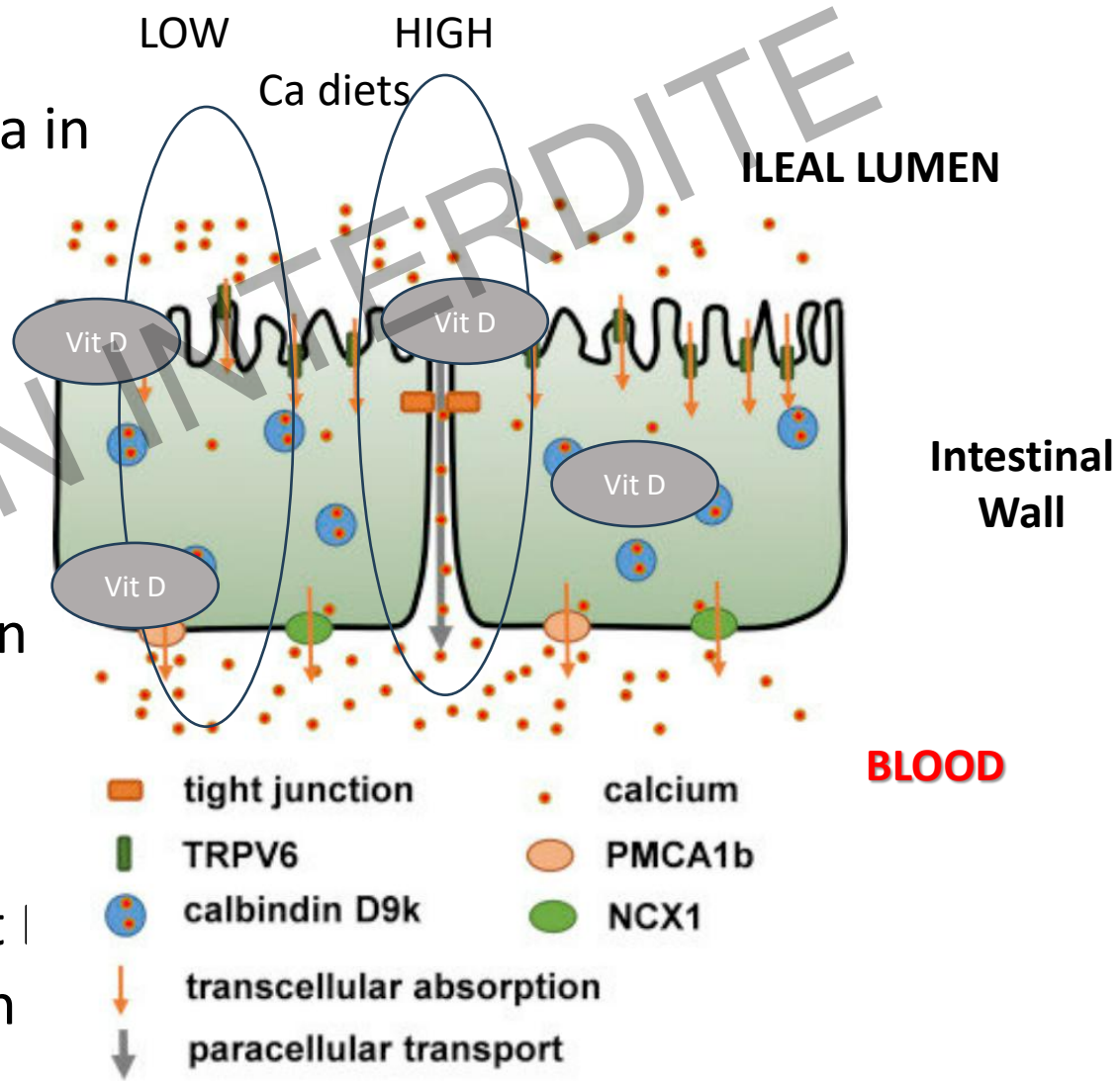
- ✓ Skeleton component (99% of the amount of Ca in the body is found in the skeleton)
- ✓ Essential component of cells and tissue fluids
- ✓ Essential for transmission of nerve impulses, muscles, eggshell formation

Digestion:

After solubilization, uptake of Ca mostly in duoden and upper jejunum

Uptake through

- ✓ Active pathway, which requires energy and vit
- ✓ Passive absorption with high Ca diets (through tight junctions (paracellular)



Pu et al., 2016

P: key role

Importance:

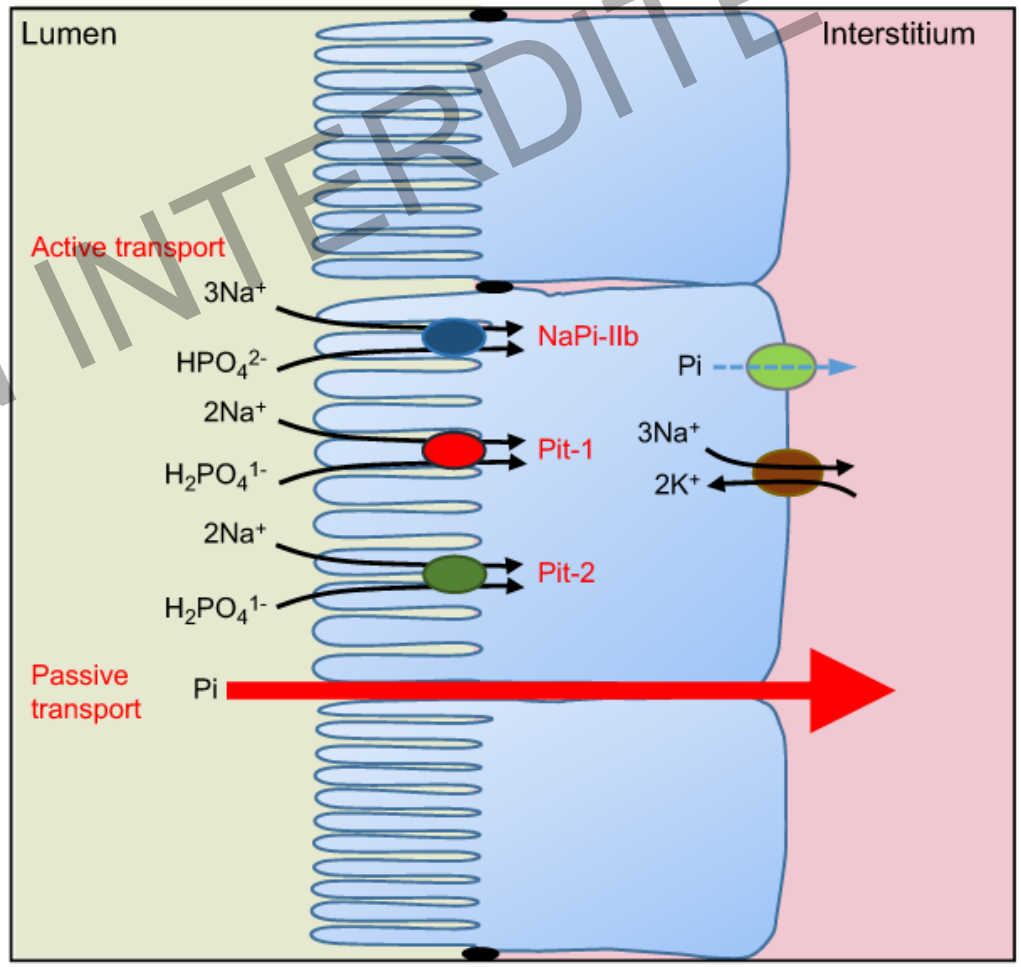
- ✓ Component of skeleton (80-85% of the P in body),
- ✓ Important function energy metabolism

Digestion:

Uptake of P mostly in distal ileum, P is absorded in form op phosphate

Uptake through

- ✓ Active pathway, which requires vit D
- ✓ Passive absorption
- ✓ World wide store is limited!

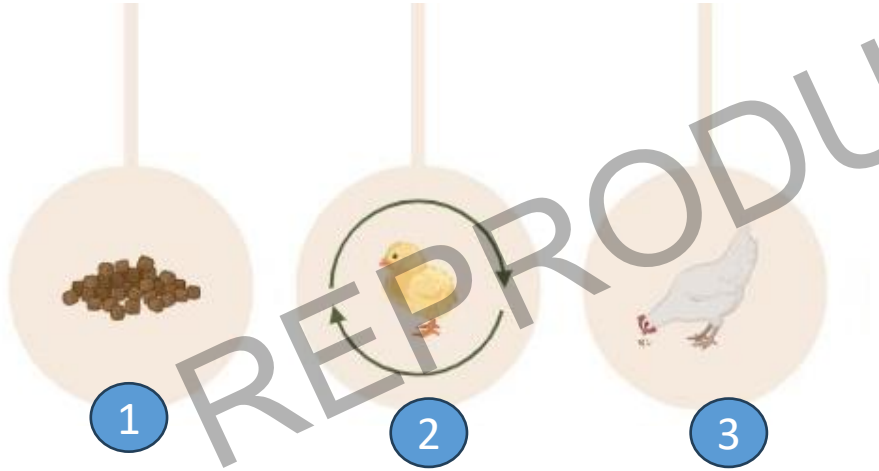


Knöpfel et al., 2019

Limited P supply: increase dietary P-efficacy?

Priming of young layers to effectively utilize P during laying: interactions between P level, feed form and diet moisture

Experimental set-up



1. 2 (P) x 2 (M) x 2 (P) :
   - Low or moderate aP level (MCP red.): 1. 6 and 1.9% (P)
   - Dry vs wet diet (1:1) (M)
   - Coarse or fine particle size (P)
2. Pre-layer 16-19wk and Layer 20-27wk Novogen White type laying hens
3. Performance, GIT measurements, bone quality, egg quality

Dijkslag et al., 2019

Performance layers (19-22wks)

		Feed intake (g/d)	Egg mass
Diet Moisture			
	Dry	99.2	32.6
	Wet	**103.1**	**33.3**
Non-Phytate P			
	aP 1.6	99.5	30.9
	aP 1.9	**101.1**	**32.6**
Diet Particle size			
	Fine	**101.1**	33.22
	Coarse	99.4	32.02
P-values			
	Diet Moisture (M)	**< 0.001**	**0.046**
	aP level (P)	**0.010**	**0.033**
	Particle size (P)	**0.011**	0.321

No differences in FC

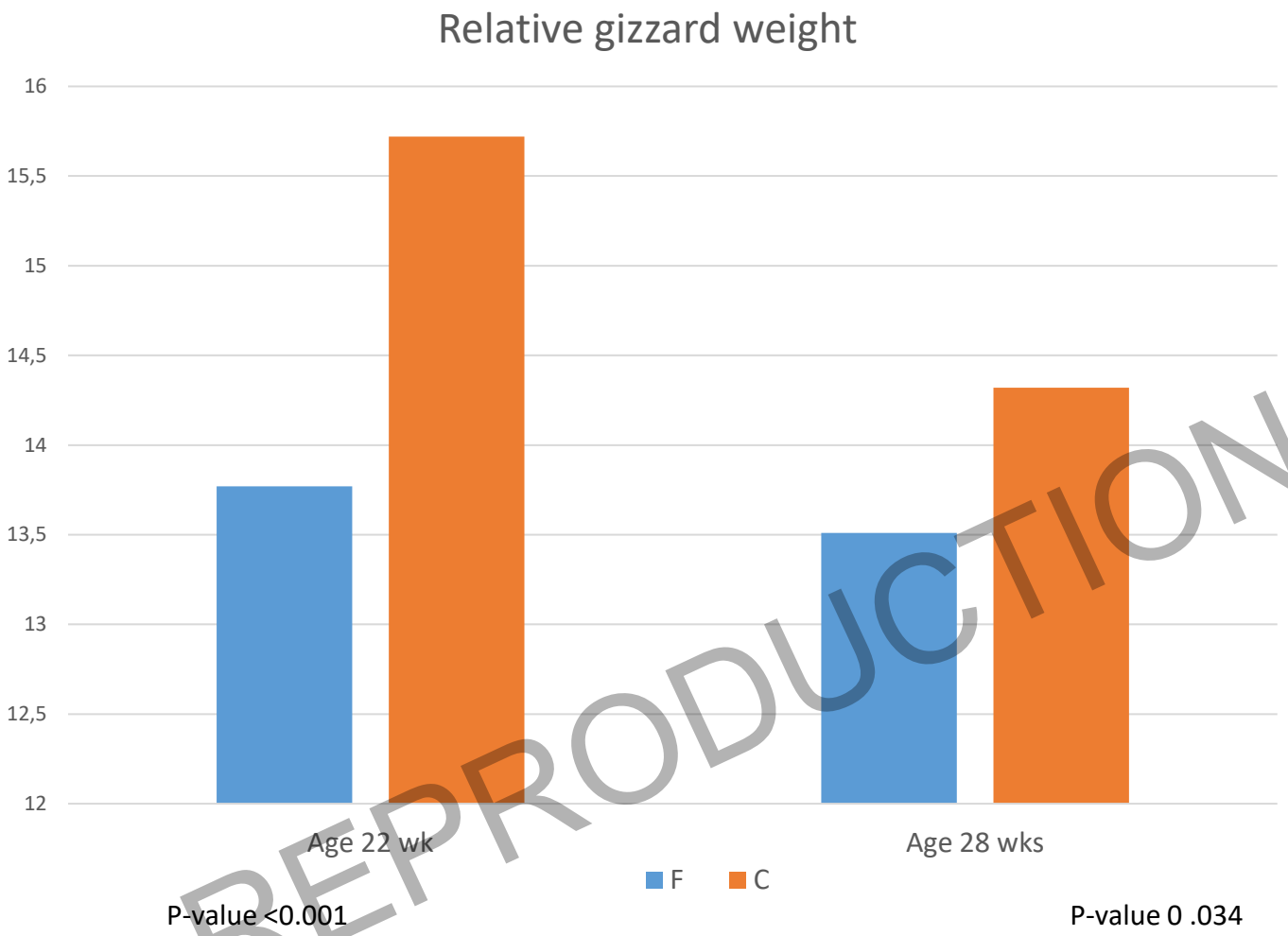
Dijkslag et al., 2019

Performance layers (23-27wks)

		Feed intake (g/d)	Egg mass
Diet Moisture			
	Dry	113.5	50.12
	Wet	**116.0**	**50.95**
Non-Phytate P			
	aP 1.6	114.7	50.41
	aP 1.9	114.9	50.66
Diet Particle size			
	Fine	**115.5**	**51.14**
	Coarse	114.1	49.92
P-values			
	Diet Moisture (M)	**< 0.001**	0.080
	aP level (P)	0.715	**0.539**
	Particle size (P)	**0.012**	**0.007**

No differences in FC

Dijkslag et al., 2019



P-value <0.001

P-value 0 .034

No effect on

- Feed conversion
- **Tibia characteristics**

Dijkslag et al., 2019

RESULTS:

- **A low NPP diet**: No significant effect

  Levels of aP really to low? *The NPP requirement for young layers might therefore be overestimated in practice*

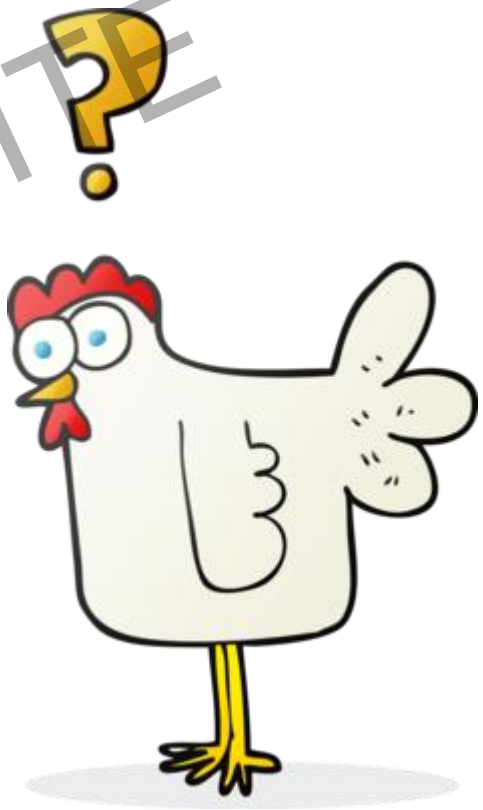
- **The wet diet:** Increased FI, Egg weight and Production

- **The coarse diet:** Increased egg shell breaking strength, relative gizzard weight and reduced FI and egg production

Dietary treatments did not affect **tibia characteristics** until 27wk of age

UNANSWERED…

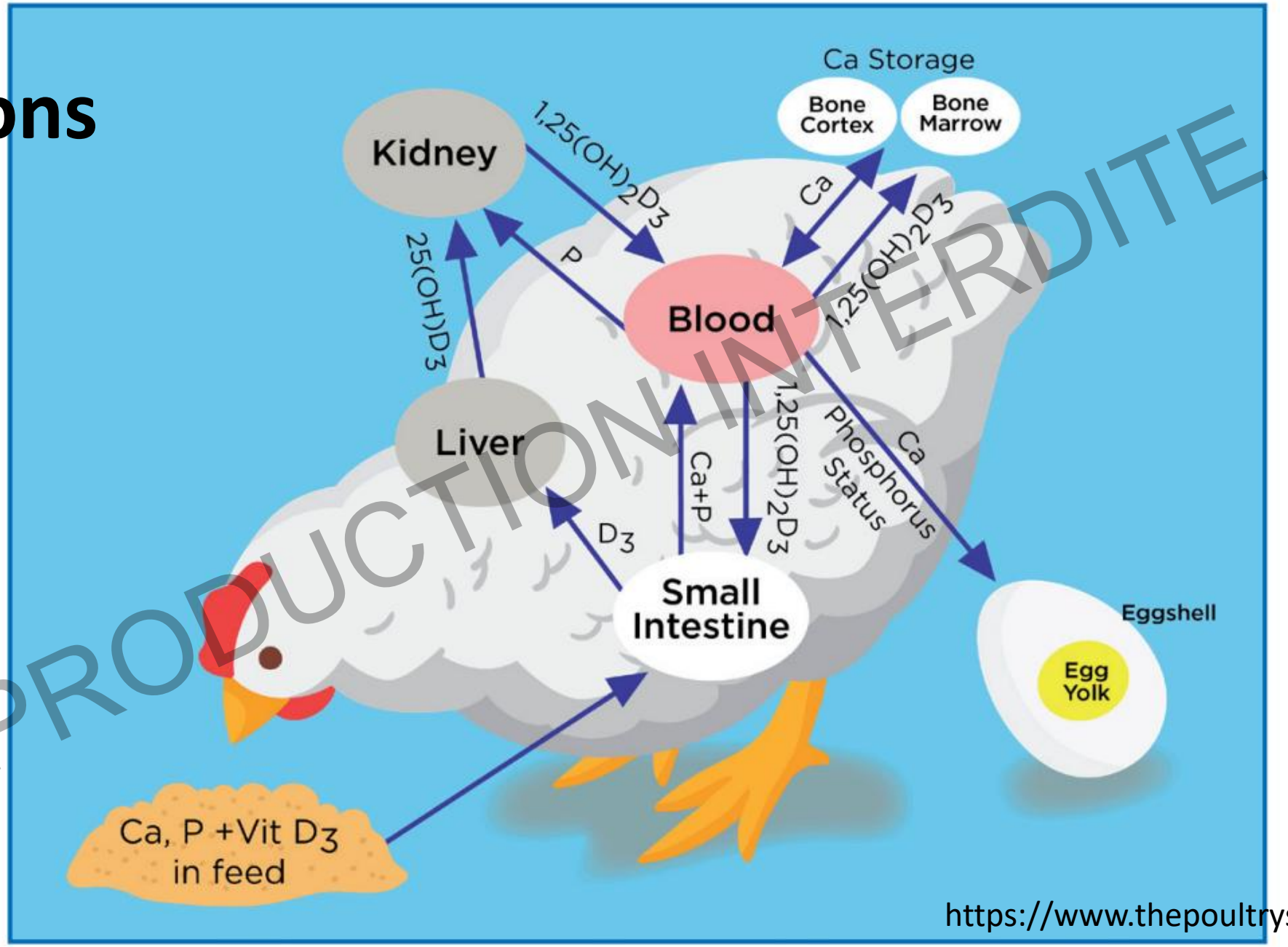
- Whether feeding a combination of coarse and wet diets would benefit older birds depleted (?) in dietary NPP.



BUT

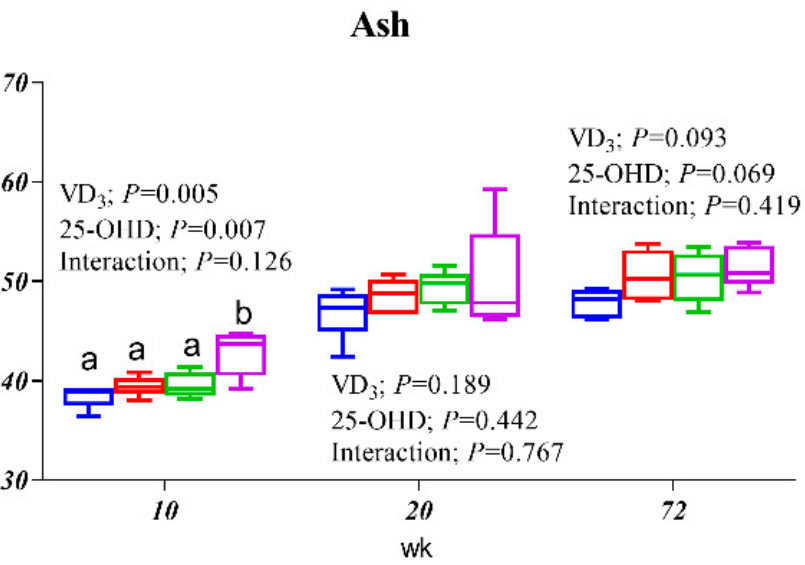
- Coarse diets tended to increase breaking strength, indicating that dietary structure might play a greater role in egg quality of young layers than NPP level.

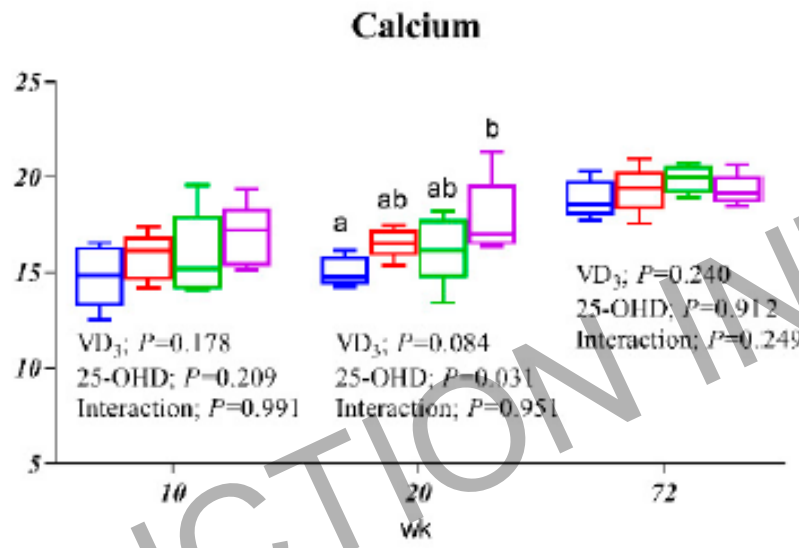
Interactions

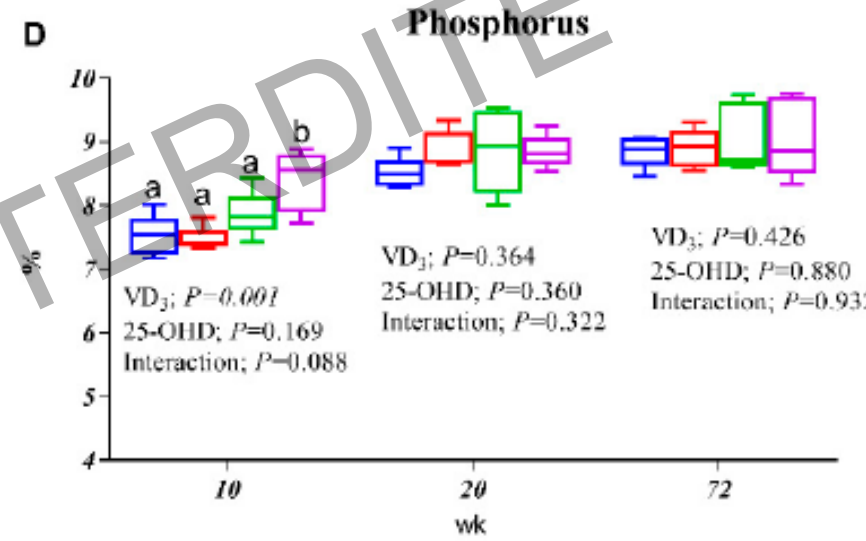


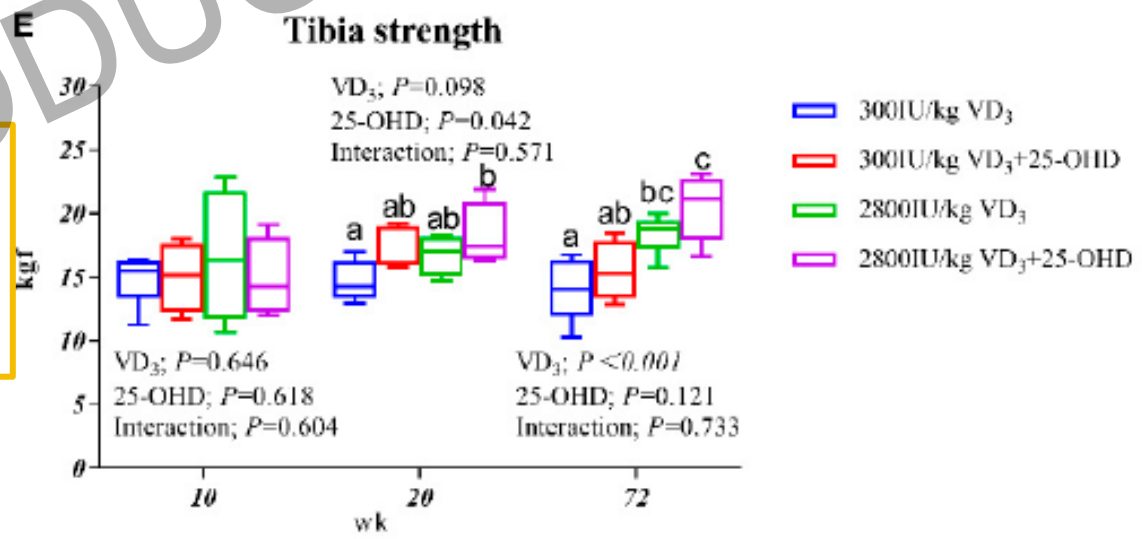
https://www.thepoultrysite.com

Rearing diet: vit D_3 and 25-OHD









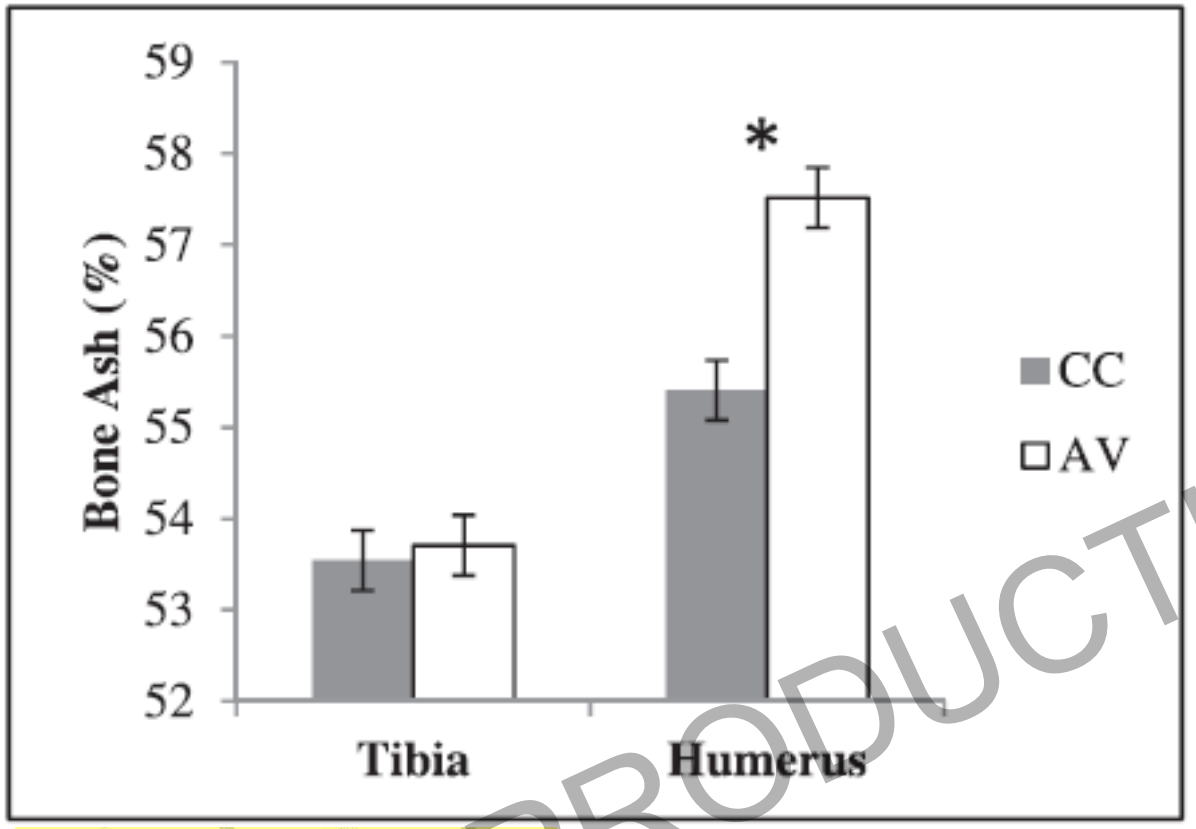
Diet treatments until 20 weeks of age

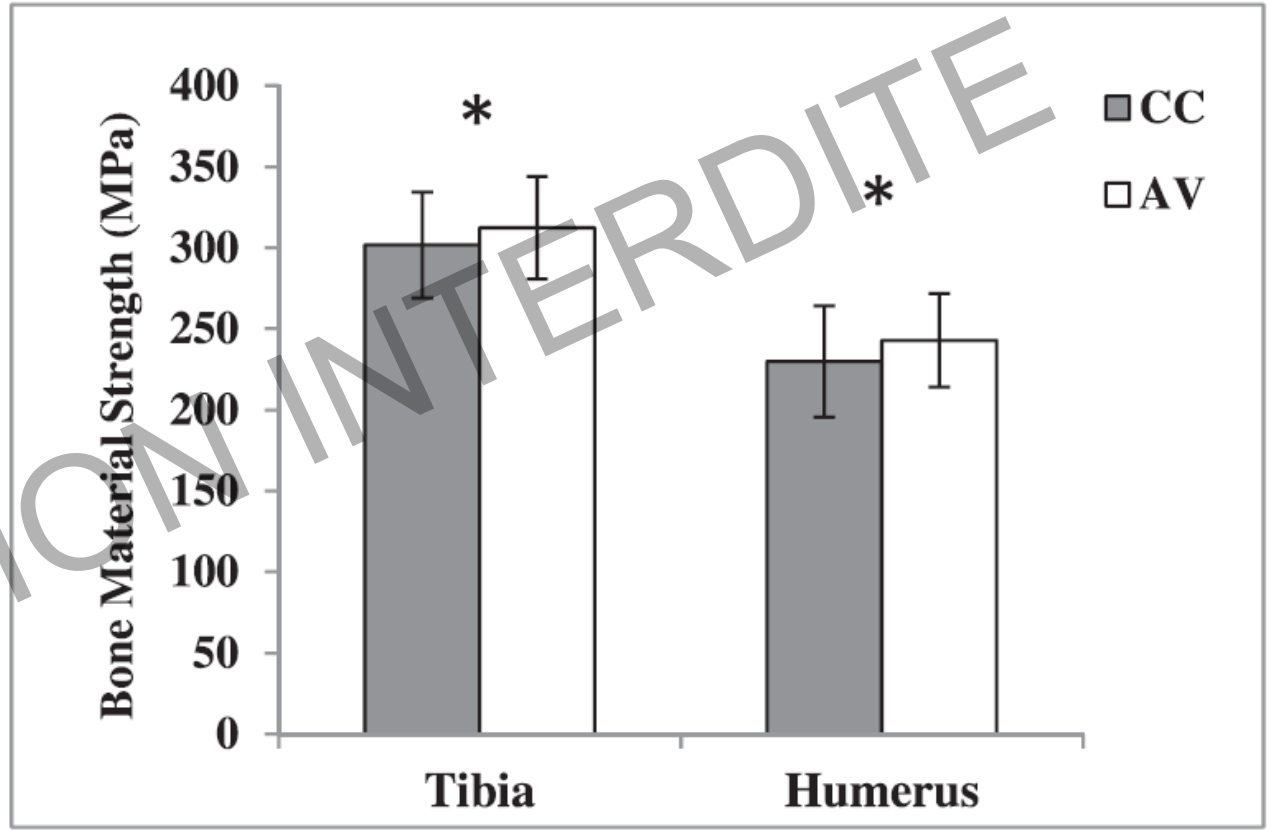
- 20w same standard diet
- until 72 wks of age

COQU'idées
POUR LE BIEN DES PONDEUSES

Li et al., 2021

Rearing environment (16 wks of age)





Skeletal loading provided by activities within pullet AV housing improved the load-bearing capability and stiffness of the tibia and humerus.

Regmi et al., 2015

3. Guth Health
Development and feed structure

Gut feeling, Egg-xellent sense

- Few papers on pullets
- Factors studied:
  - ✓Feed Form
    - Crumble or mash?
  - ✓Fibre
    - Do we need fibre and how much?

Crumble or Mash ?

Saldaña et al., 2015

Feed Form	ADFI (g/day)	ADG (g)	FCR	Rel. gizzard weight	Rel. gizzard weight	Gizzard pH
		0-120 d		70 d	120d	120 d
Crumble	51.9[a]	12.3[a]	4.21[a]	3.1[a]	2.9[a]	3.88[a]
Mash	50.4[b]	11.5[b]	4.36[b]	5.0[b]	4.4[b]	3.17[b]

- Changes from crumble to mash at 5 and 10 wks gave intermediate results
- Feed form during rearing did not affect performance or GIT during lay

"Pullets that changed from crumble to mash (at 5 or 10 weeks of age) always responded directly with a decrease in ADG and an increase in gizzard weight"

"Young pullets appear to have less ability to increase voluntary FI when low energy, bulky diets are fed in mash form"

Do we need fibre? How much? (0-5wk)

Guzman et al., 2015

Feed form	ADFI (g/d)	ADG (g)	FCR	Rel. gizzard weight	Rel. gizzard weight	Gizzard pH
		0-120 d		70 d	120 d	70 d
No straw	48.9	12.0	4.09[a]	4.2[a]	3.6	2.94
Straw 2%	49.3	11.8	4.16[b]	4.3[a]	3.8	2.60
Straw 4%	49.6	11.8	4.20[b]	4.7[b]	4.0	2.43

"Moderate amounts of an insoluble fibre improve pullet growth, especially at young ages"

"We recommend to include at least 2% of insoluble fibre to improve GIT development and maximize growth"

Pilar Guzmán

4. Behaviour

Feather pecking and feeding strategies

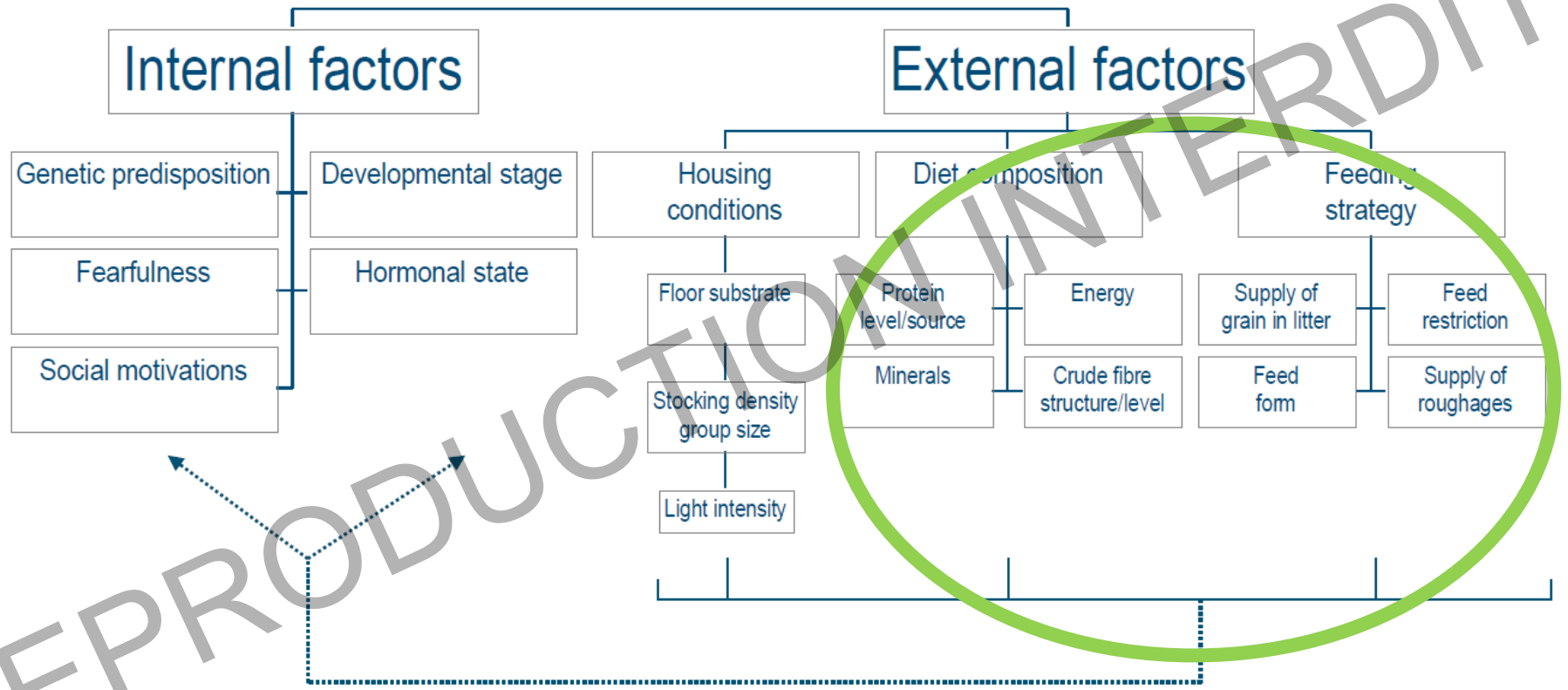
Feather eating

- **Indicators and Correlations in Feather Pecking (FP)**
  - Absence of feathers on the ground may indicate a problem.
  - FP shows a **negative correlation** with the presence of short feathers on the ground.
  - FP shows a **positive correlation** with the occurrence of “droppings + feathers.”
- **Nutritional Considerations**
  - Feathers (β-keratin) provide no nutritional value compared to insoluble fibre.
- Question: *Why does feather eating (FE) shift towards feather pecking (FP)?*
  - Possible causes: lack of satiety and frustration (redirected behaviour).
  - Imbalance in dietary composition (amino acids, fibre, etc.).
- **Importance of the rearing phase**
  - Sensitive period, gut-brain axis (10w) , nutritional strategies during early rearing

Factors affecting FP behaviour

Breeding choises focused on:

- animal-friendly traits
- Beak shape



WAGENINGEN UNIVERSITY & RESEARCH

Van Krimpen et al., (2005)

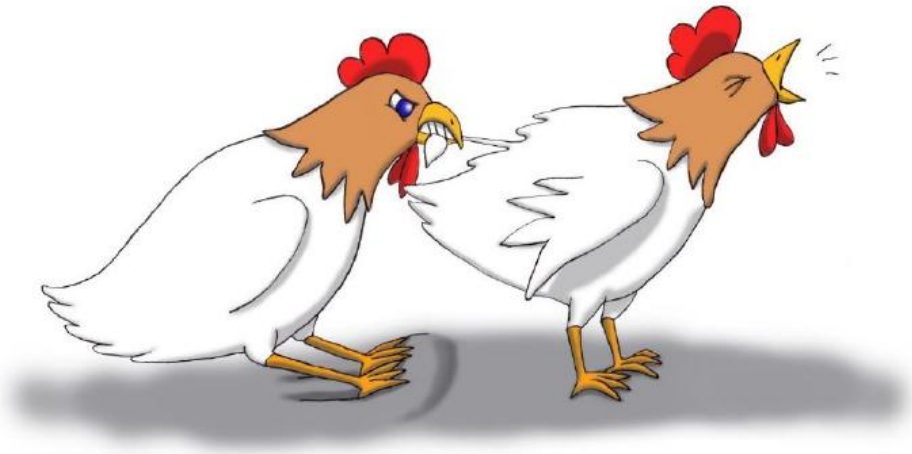
coqu'idées
Pour le bien des pondeuses

External Factors affecting FP behaviour

- **Feeding strategy**
  - Enrichment ‘occupation’: picking stones, straw bales
  - Longer eating time (fibre, dilution)

- **Feed composition**
  - Fibre
  - AminoAcids /serotonin

- **Rearing**



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Feeding strategy

Longer eating time results in less feather damage in pullets

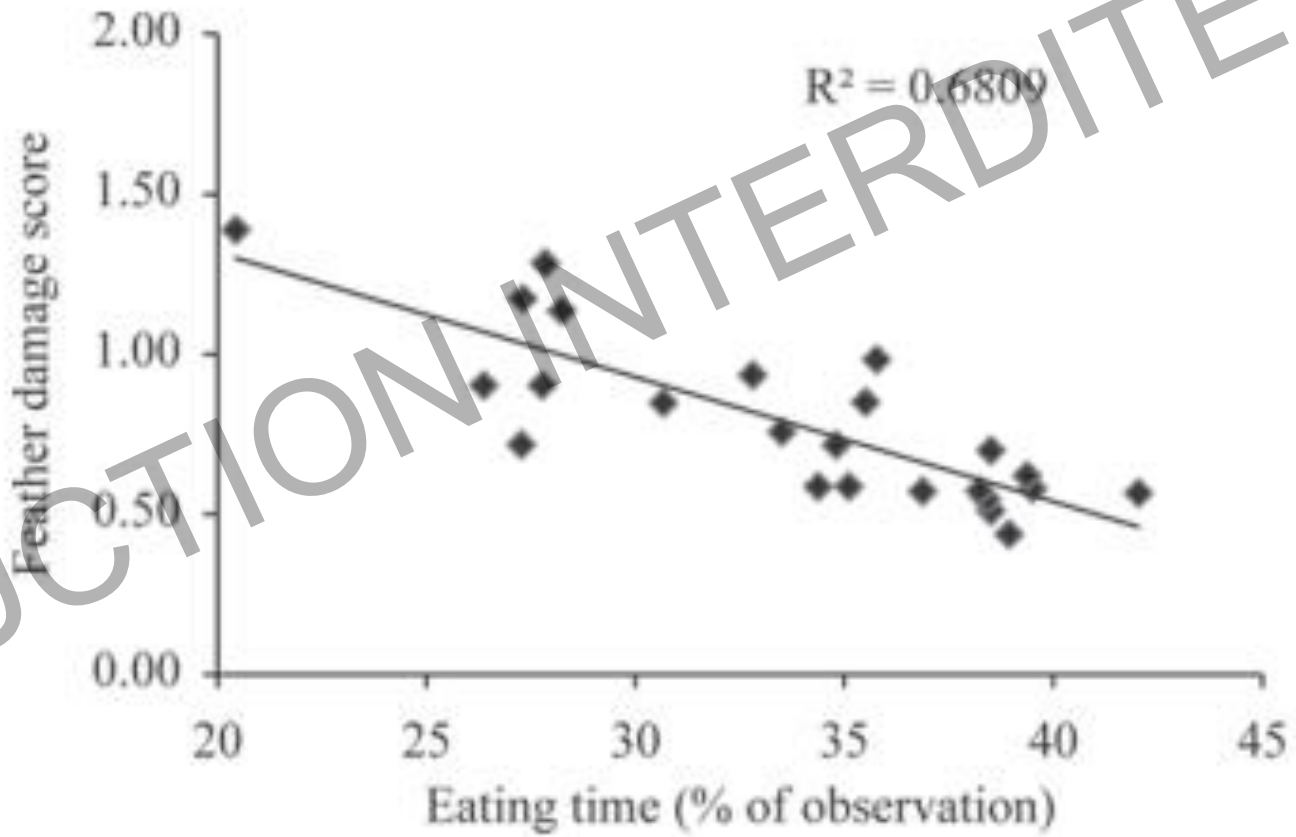
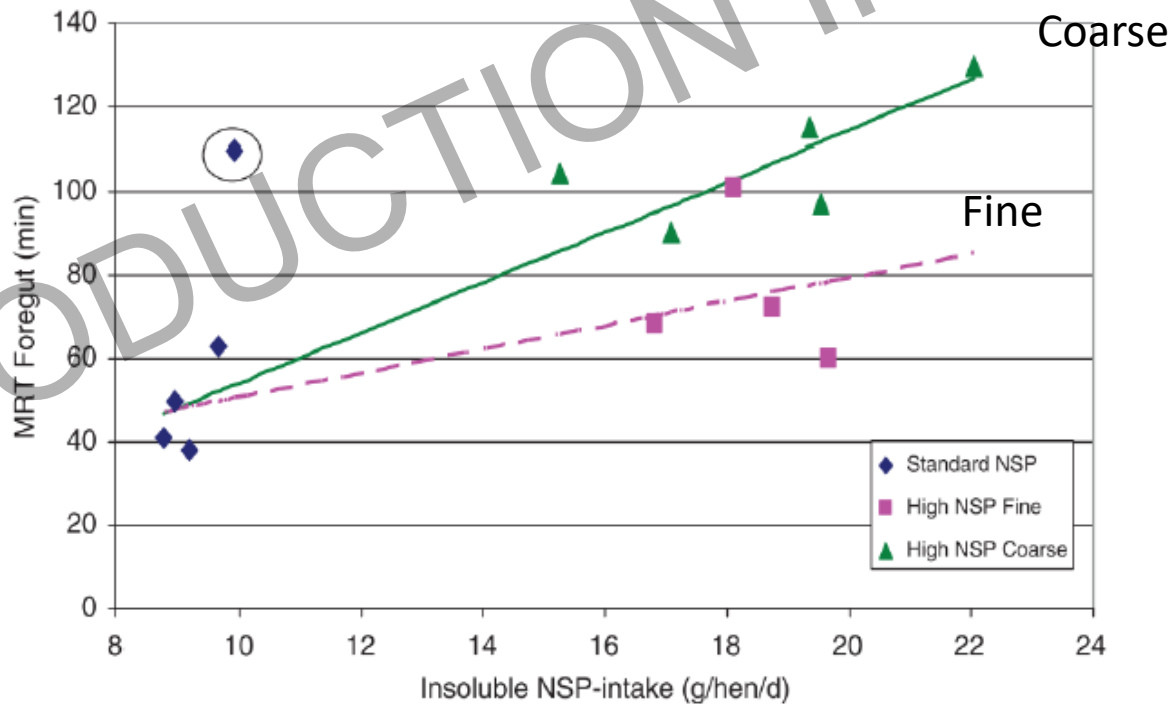


Figure 7. Relation between eating time and feather damage score in Lohmann Brown pullets during the rearing period. Feather damage score varied from 0 (intact feathers, no injuries or scratches) to 5 (completely denuded area).

Qaisrani et al. (2013)

Feed composition: FIBRE

- High NSP level = lower prevalence of FP (satiety)
- High NSP level: effect on GIT and digestibility
- High NSP level: reduced foraging behaviour (desired?)
- Coarse vs Fine NSP: higher satiety? Effect on mean retention time (MRT): Longer retention time in crop/gizzard:



Feed composition: AA

TRYPTOPHANE = precursor of serotonin (neurotransmitter)

FP : deficiencies in central serotonin during rearing, peripheral ?

FP: deficiencies in peripheral serotonin (gut)

Not just solved by supplemening tryptophane

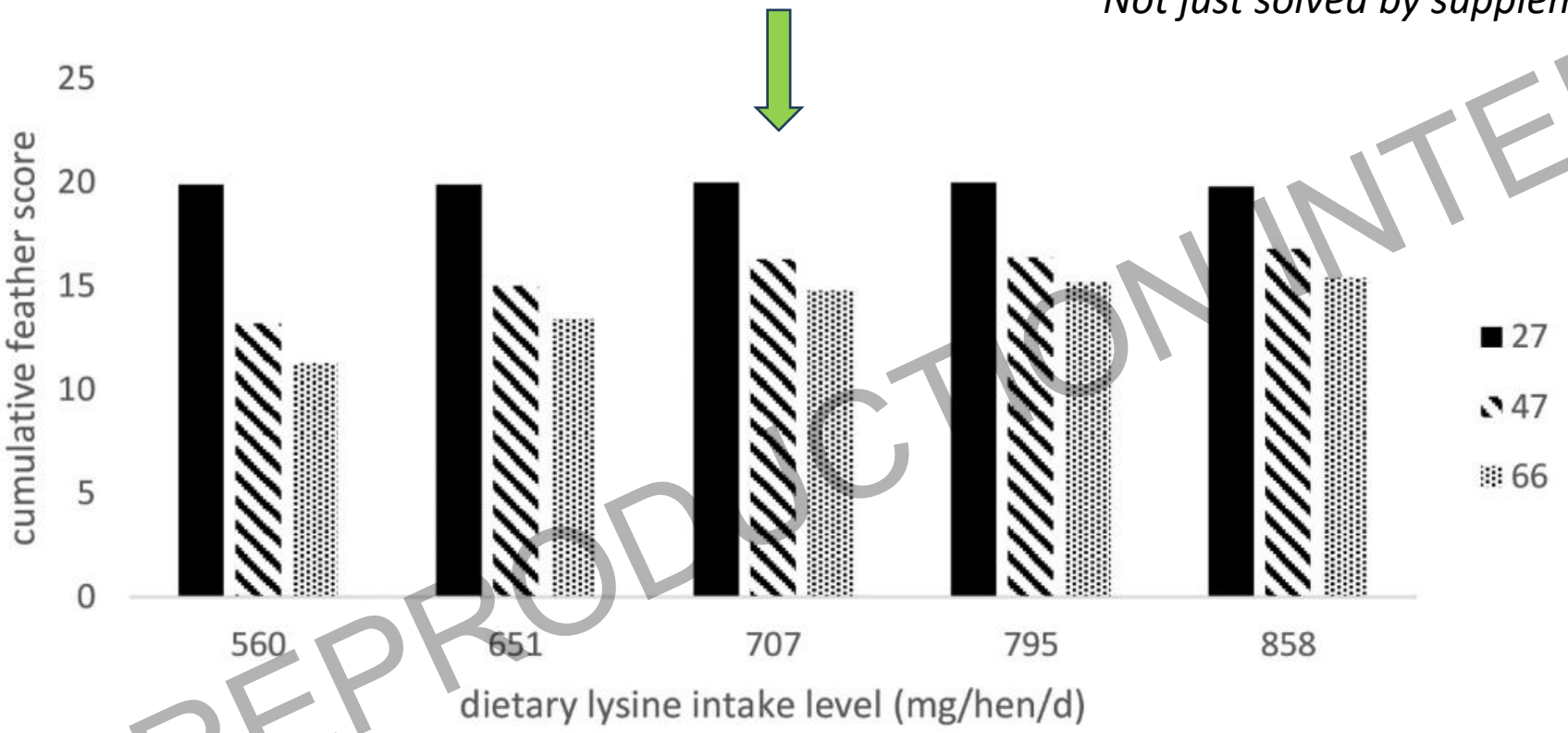


Figure 3. Effect of lysine intake level (mg/hen/day) on mean cumulative feather score from 1 (completely featherless) to 4 (fully feathered) at five body areas: neck, back, vent, wings and breast, of laying hens fed different dietary lysine levels at 27 (black), 47 (striped) and 66 (dotted) weeks of age. Adapted from Kumar *et al.* (2018).

To conclude

- FP important (welfare) problem, prevalence of SFP above 50%
- Nutritional point of view: Reduction of FP
  - DIRECT effect: physiological mechanisms (on serotonine production, satiety)
  - INDIRECT effect: behaviour (prolonged eating time, occupy hens, increase foraging behaviour)
- To prevent FP: rearing period?!

Built to last:
Shaping the future layer form day one

What this means…

- 1. Allometric growth
  - Adapted models
  - Body weight but also body composition: feed intake!))
- 2. Bone quality
  - Dietary structure more important than NPP
  - Importance of vit D_3 and metabolites
  - Activity of pullets
- 3. Gut health
  - Mash feeds increased development of GIT
  - Mash feeds decreased FI
  - Moderate amounts of fibre
- 4. Behaviour
  - Keep rearing hens busy, feed formulation
- **5. FI** can be increased by wet feeds, pellets/ crumbles: important for BW !

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Thank you!

QUESTIONS?

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