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Lameness in Broilers

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Introduction

- Terms “leg problems”, “leg weakness”, “lameness” and “leg disorders” are used fairly interchangeably.
- Lameness - less of an issue than a decade ago.
- Perhaps we underestimate it ?
- 10 - 30% of European broiler flocks suffer (Blokhuis 2019)

Introduction

- Painful leg disorders caused by:
  - Skeletal abnormalities (acute).
  - Tendons, ligaments, articulations and nerves (chronic).
  - Bone and joint infections (insidious).

Introduction

- Lameness impacts:
  - Welfare (pain).
  - Restricts natural movement (eat and drink less)
  - Product quality (breast blisters, scratches and inflammation)
  - Reduces profitability.
- Skeletal abnormality & lameness, indicated by poor gaits.
- Poor gait - associated with high morbidity and mortality.
- Gait – has major impact on welfare audits.

Introduction

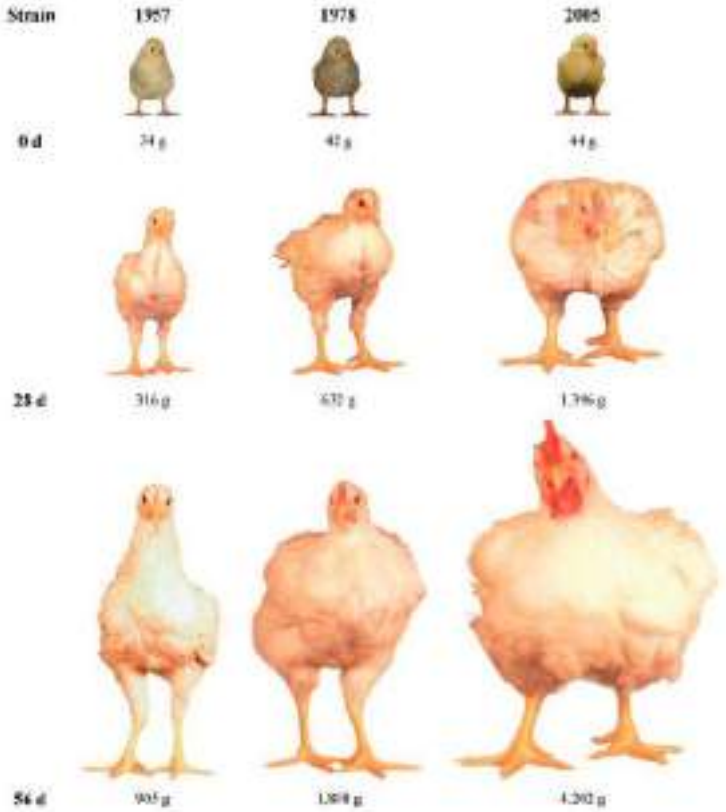
- Lameness exacerbated by:
  - Fast early growth rates.
  - Final bodyweight – locomotion decreases in large birds.
  - Inappropriate nutrition.
  - Poor gut health.
  - Infectious diseases.
  - Poor management practices.
- This talk will focus on nutrition/feed induced lameness.

Growth Rate

- Modern genotypes:
  - Shorter growing cycles.
  - More weight on skeleton earlier.
  - Gait has changed.
- Yet primary breeders have done a remarkable job.

Broiler Changes

(Zuidhof *et al*., 2015)



Leg Abnormalities in Aviagen Birds

(Neeteson et al., 2016)

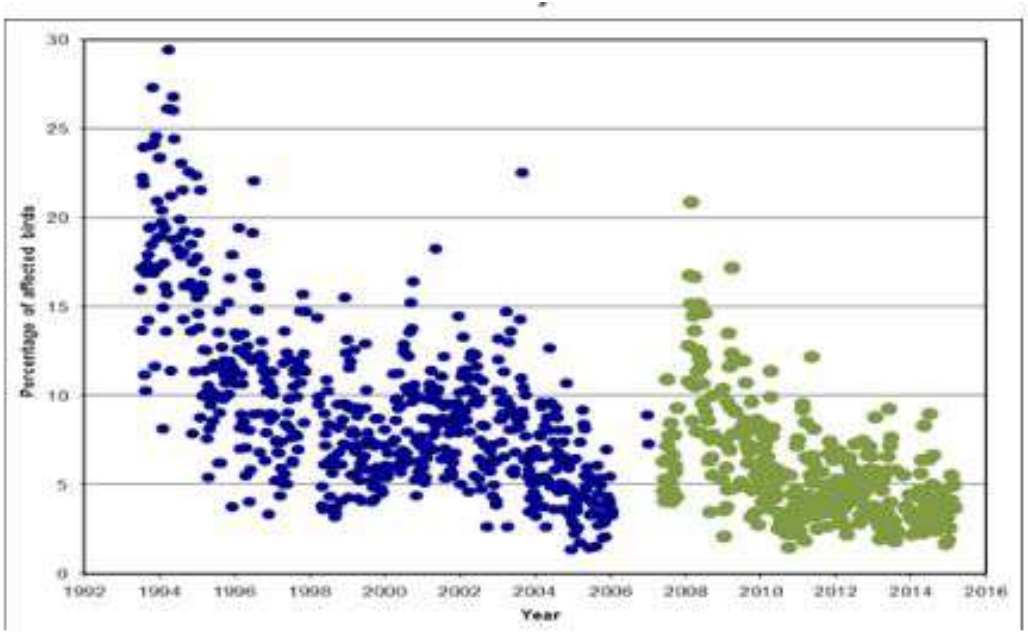
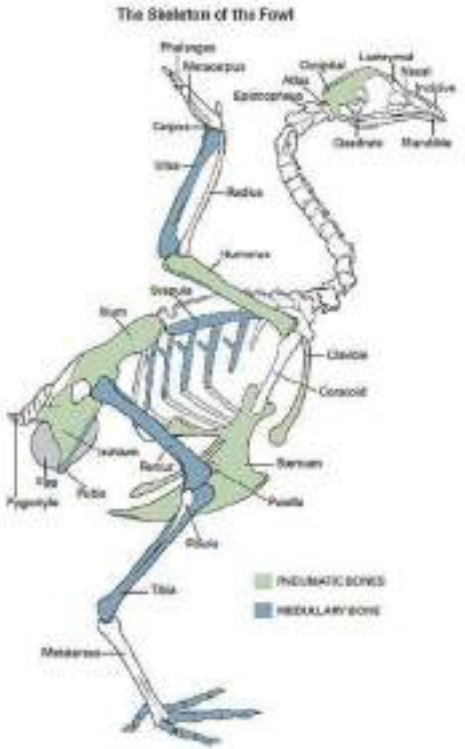


Figure 2. Trend graph of Tibial Dyschondroplasia improvement of Ross 308 pedigree birds (1992-2016) using Lixiscope. Blue: 1st generation Lixiscope. Green: 2nd generation Lixiscope.

X-ray device (Lixiscope)

The Skeleton and Nutrition



Skeletal Integrity

- Skeleton – important component of overall health.
- Cartilage development - critical.
- Robustness – required for growth & processing.
- More important as growth rates increase.
- Uncertainty – still exists over nutrient requirements.

The Skeleton

- 99% of Ca, 80% of the P in the body.
- P - 30% of skeletal ash.
- Ca & P interact before & after absorption.
- Mostly high Ca inhibits P uptake.
- Vit D maintains complex balance between Ca and P.

Skeletal Development

- Begins 12 days prior to lay – nutrient deposition yolk.
- Bone – calcification plateaus after 19 days.
- Adequate Ca – shortfall of other minerals.
- Easy to deprive embryo of minerals.
- Difficult to boost egg mineral content.

Skeletal Development

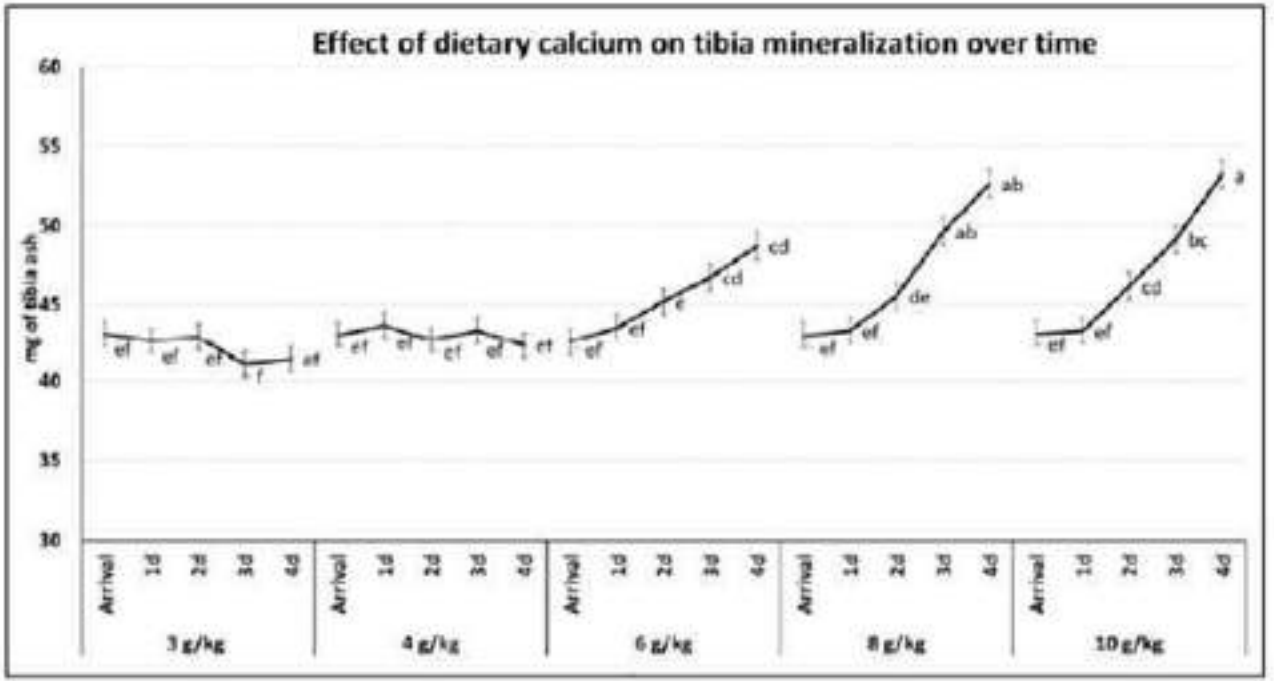
- Fast growing embryo’s – exceed mineral deposition capacity.
- Young hens – reduced egg minerals .
- Porous bone structure at hatch.
- Bones relatively poorly mineralised.

The Skeleton

- After hatch.
- Rapid bone formation 2 to 18 days of age.
- Rapid mineralisation 2 to 11 days.
- Starter period is critical!

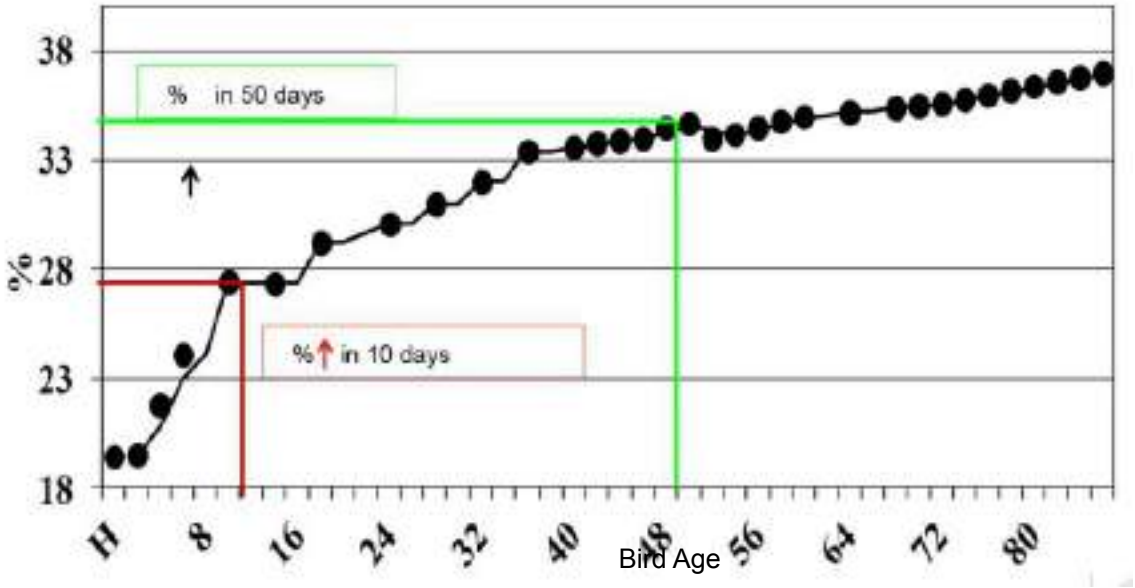
Ca level and Tibia Ash

(Torres et al., 2018)



Rate of Bone Mineralization

(Angel, 2013)



Skeletal Development

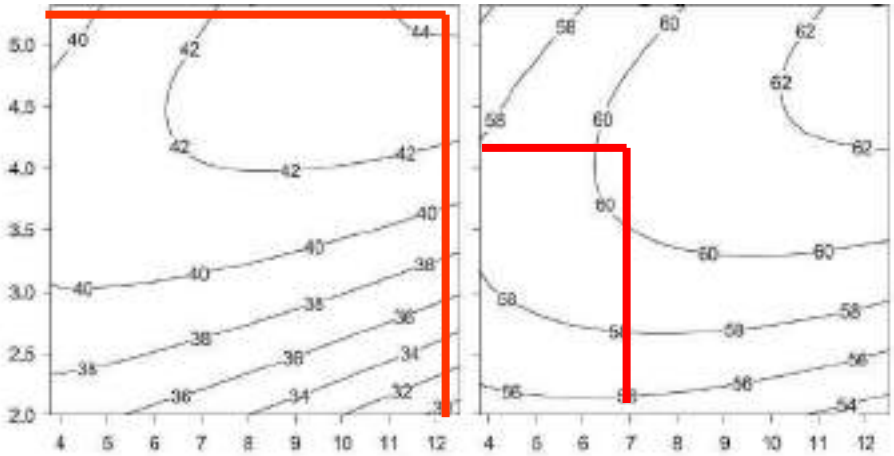
- Phytase changes everything we know about Ca and P.
- Phytase - increases apparent retention of Ca and P.
- Understanding far from complete.
- Requirement differ - bone mineralisation and growth.
- High Ca – levels:
  - depress feed intake.
  - suppress phytase activity.

NPP, Ca and Tibia Ash

Faridi et al., (2015)

No Phytase

600 FTU Phytase



All diets contained D3 (50µg/kg)

Ca, Avl P and Phytase

(Kim et al., 2017)

	Dietary Ca concentrations (g/kg)					
	4	5	6	7	8	9
35 d Weight (kg)	1.93	1.96	1.912	1.954	1.888	1.889
FCR*	1.73	1.69	1.76	1.73	1.80	1.83
Tibia Ca%	42.5^{c}	46.4^{b}	49.7^{a}	47.6^{ab}	48.4^{ab}	48.4^{ab}
Breaking strength (kg/cm^3)	20.4	19.5	22.3	20.1	23.7	22

* Significant on linear basis.

Diet Formulation

- Understanding of requirements far from complete.
- Systems of P measurement - not interchangeable.
- Digestible P – amount retained by animal
- Chemical measurement of NPP – straightforward.
- Yet – poor indicator for key ingredients.

Some Common Feed Ingredients

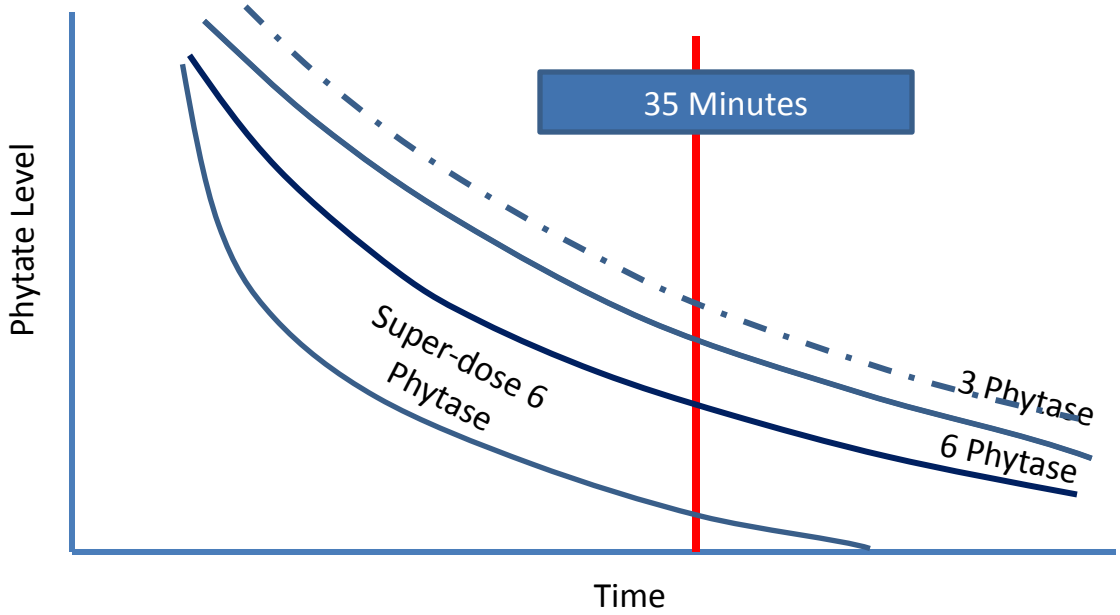
(Ravindran, 2018)

	Non-phytate P	Digestible P
Monocal Phos	100	85
Maize	31	68
Wheat	34	46
Soybean Meal	33	80
Rape Seed	29	47
Meat Meal	100	42-69

Formulation

- Phytase now added to almost all broiler diets.
- Phytase efficacy dependant upon:
  - Type and dose of phytase
  - Level of IP in the diet.
  - Time available.
  - Age of the bird.

Phytate and Phytase in the broiler GIT



Different Phytase

(Leyva-Jiminez et al., 2018)

Product	Body Weight (22 days)	FCR (22 days)	Tibia Ash (%)
Opitphos 2000 PF	884.2^{y}	1.43	48.6^{xy}
Quantum Blue 10G	840.6^{z}	1.46	47.7^{y}
Axtra PHY2500	885.8^{y}	1.42	48.9^{x}
HiPhos GT 2500	871.1^{y}	1.44	49.1^{x}

Real IP Values in Corn/Soy Diets

NUTRIENTS		Starter	Grower	Finisher	Change (%)
ME Poultry	kcal/kg	3000	3200	3300	
Crude Protein	g/kg	230.00	210.00	180.00	
Inositol Phosphate	g/kg	2.84	2.50	2.40	15

Formulation

- Clearly - the use of a single matrix flawed.
- We require accurate knowledge of dietary phytate.
- An understanding of the enzyme to be used.
- Calculate of expected P “yield” for each circumstance:

70% destruction with 2.5 g IP/kg = 1.75 g/kg

Current Practice

	Cobb 500 (2018)	Aviagen (2019)	AGRISTATS (reported by Angel, 2016)
Starter			
Calcium (g/kg)	9	9.6	10
Available P (g/kg)	4.5	4.8	4.8
Ca: Avl P Ratio	2	2.1	2.1
Grower			
Calcium (g/kg)	8.4	8.7	10
Available P (g/kg)	4.2	4.35	4.4
Ca: Avl P Ratio	2	2	2.3
Finisher			
Calcium (g/kg)	7.6	7.9	8.5
Available P (g/kg)	3.8	3.95	4
Ca: Avl P Ratio	2	2.02	2.1

INRA Recommendations

(after Khaksar et al., 2017).

	Starter	Grower I	Grower 2	Finisher
Bird age	0 -10	11-20	21 - 30	31 – 40
Ca (g/kg)	9	7.6	6.4	5.4
Av Phos (g/kg)	4.3	3.75	3	2.5
Ca:Av P	2.1	2.0	2.1	2.2

Maryland Recommendations

(Angel, 2019)

	Starter	Grower I	Grower 2	Finisher	Finisher 2
Bird age	0 -10	11-18	19-26	27-34	30-40
Body Weight (g)[1]	261	675	1458	2310	3070
Ca (g/kg)	10	8.1	7.0	5.5	5.0
Dig Phos (g/kg)	5.3	3.7	2.9	2.3	1.7
Ca: Dig Phos	1.9	2.2	2.4	2.4	2.9

Other Nutritional Issues

- Protein and energy should not be overlooked.
- Lameness mostly caused by vitamin and mineral issues.
- Well described pathologies.
- Follow primary breeder guidelines & add good premix
  – should never see these problems.

Management and Feeding Issues

The Hatchery

(Balloy, 2017)

- Development of broilers begins during incubation.
- Modern genotypes – double heat output.
- High incubation temperature common problem:
  - Characterised by birds with pale fluff.
  - Poor reabsorption of yolk sac .
  - Smaller organs of GIT.
  - Poorly calcified skeleton (Angel, 2019).

Brooding Management

- Any uncomfortable condition during brooding.
- Reduces ***feed intake*** and physical activity.
- May be the beginning a poor gut health episode.
- Impacts on bones, cartilage and tendon development.

Feed Management

- Early access to feed & water - stimulates development.
- High protein diet – stimulates intestine development.
- “Seed” the microbiota with ‘beneficial's’.
- Prevent invasion by ‘harmful’ bacteria.
- Key component of good gut health.

Infectious Causes of Lameness

- Bacterial Chondronecrosis and Osteomyelitis (BCO).
- Affects > 1.5 % of broilers after 30 d.
- Epidemic - can impact up to 15 % of flock.
- Require consistent, strong growth plates and articular surfaces.
- Enhanced collagen crosslinking - lower incidences of osteochondritic micro-fracturing (Wideman, 2012)

Infectious Causes of Lameness

- Pathogens penetrate GIT or respiratory system.
- Reach susceptible growth plates via the blood.
- Sites prone to microfractures (osteochondrosis):
  - Proximal femoral and tibial growth plates.
  - Radial zone supporting the growth of articular cartilage.
  - Flexible thoracic vertebrae

Gut Health & Litter Quality

- Healthy gut may help prevent or limit BCO.
- Compromised gut – susceptible to pathogen onslaught.
- Malabsorption induces rickets and/or osteoporosis of proximal femur.
- “Flushing syndrome” - leads to wet litter.

Gut Health & Litter Quality

- Footing instability - leads to growth plate trauma and subsequent bacterial infection.
- Skeletal defects – knee problems (varus/valgus) deformities and kinky back (spondylolisthesis) are exacerbated.
- Failure to stand - contact dermatitis, lameness, negative emotional state, and fear of humans.

Take Home Message

- Profit & welfare addressed through reduced lameness.
- Multi-factorial problem.
- Not helped by modern practice.
- Sound farm management required.
- Ensure good early skeletal development.

Take Home Message

- Use phytase correctly.
- Use a well formulated premix.
- Avoid gut health issues.
- Good motivation to address the issue.