Phosphorus Nutritional Conditioning in broiler chickens

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Background:

- Chickens under an early dietary nutrient restriction (**nutritional conditioning**) may respond by increasing absorptive capacity or metabolic utilisation for this nutrient.
- This may be used as an strategy to improve the efficiency of nutrient utilisation later in life.

Objective:

To investigate **phosphorus** nutritional conditioning as a feeding strategy to improve the lifetime performance and nutrient utilisation of P in broiler chickens.

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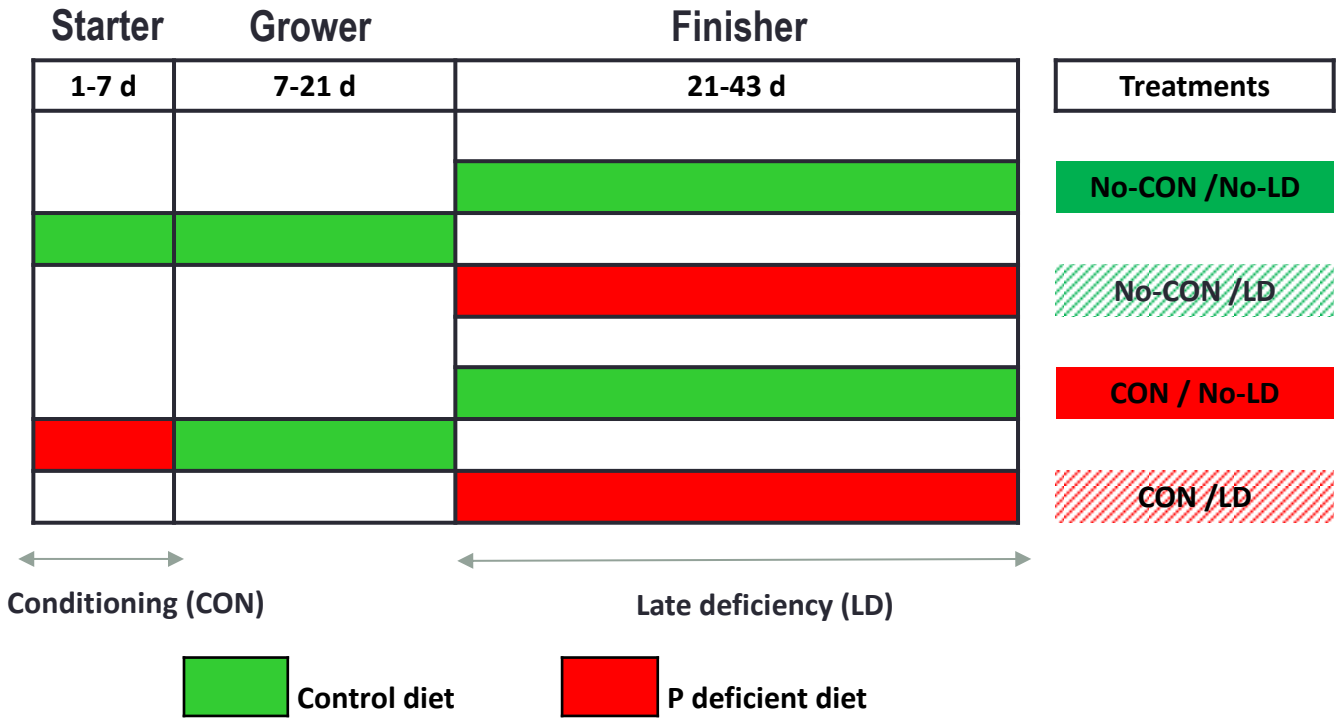
Material & Methods

Feeding program



6.9 & 4.5 (↓34%)	6.5	5.8 & 3.5 (↓ 40%)	g/kg Total P
4.5 & 2.1 (↓ 53%)	4.2	3.5 & 1.2 (↓67%)	g/kg NPP
9.0 & 5.9	8.4	7.6 & 4.5	g/kg Ca (Ca/tP=1.3)

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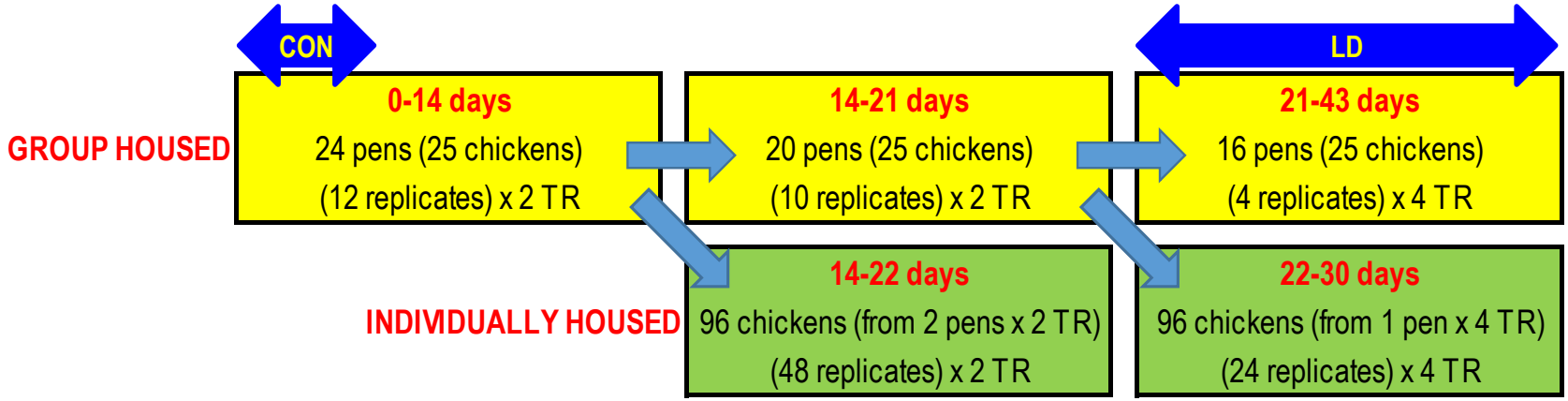
Material & Methods

- 600 day-of-hatch male broiler chickens Cobb 500 FF allocated in 24 pens
- Number of replicates x TR:



- Complete Randomized Block Design
- Experimental unit: pen/chicken
- Statistical analysis Model: ANOVA

  (Block, CON 0-21 d / Block, CON, LD and CON x LD interaction 21-43 d)

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Material & Methods

Measurements PENS (group):

- BW, WG, FI and FE: 0-7 d, 7-14 d, 14-21 d, 21-42 d
- Ileal P digestibility
- Tibia mineralisation } at D43
- Product quality
- Welfare assessment: D11, 29 and 38

Measurements CAGES (individually):

- BW, WG, FI and FE: 14-21 d / 22-29 d
- Apparent total tract digestibility DM, energy, N and P (all birds at 21/29 d)
- 6 best and 6 worse FCR per treatment (22/30 d)
  - ❑ Ileal P digestibility
  - ❑ Bone mineralisation
  - ❑ Sampling:
    - ❑ Gut morphology and immunology
    - ❑ Gut microbiota and transcriptomic profiling

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Material & Methods: feed composition

Table 1. Composition and estimated nutrient content of diets.

	0-7 d		7-21 d	21-43 d	
Ingredients (%)	**Control**	**Low**	**Control**	**Control**	**Low**
Maize	58.24	60.61	62.98	65.26	67.62
Soybean meal 48% CP	34.19	33.81	29.32	27.18	26.81
Soybean oil	3.72	2.98	4.05	4.43	3.69
Calcium carbonate	0.630	0.741	0.599	0.646	0.747
Dicalcium phosphate	1.869	0.494	1.738	1.380	0.025
Sodium chloride	0.378	0.379	0.380	0.356	0.358
L-lysine HCl	0.248	0.255	0.250	0.146	0.154
DL-methionine	0.333	0.332	0.284	0.246	0.245
L-threonine	0.073	0.073	0.070	0.033	0.033
Ethoxiquin 66%	0.020	0.020	0.020	0.020	0.020
Premix[1]	0.300	0.300	0.300	0.300	0.300
Estimated nutrient content					
AME (Kcal/kg)	3035	3035	3100	3150	3150
Crude protein (%)	21.0	21.0	19.0	18.0	18.0
Ether extract (%)	6.21	5.54	6.58	6.98	6.31
Crude fibre (%)	2.67	2.69	2.52	2.46	2.49
Ash (%)	5.75	4.51	5.36	4.92	3.68
Lysine (%)	1.320	1.320	1.190	1.050	1.050
Methionine (%)	0.646	0.646	0.573	0.524	0.524
Methionine + cystine (%)	0.989	0.990	0.890	0.831	0.832
Threonine (%)	0.860	0.860	0.780	0.710	0.710
Tryptophan (%)	0.237	0.235	0.209	0.197	0.195
Calcium (g/kg)	**9.00**	**5.90**	**8.40**	**7.60**	**4.51**
Total phosphorus (g/kg)	**6.91**	**4.54**	**6.50**	**5.80**	**3.47**
Non-phytate phosphorus (g/kg)	4.50	2.10	4.18	3.52	1.15
Calcium /total P	1.30	1.30	1.29	1.31	1.30
Sodium (g/kg)	1.60	1.60	1.60	1.50	1.50

Ca/P ratio =1.30

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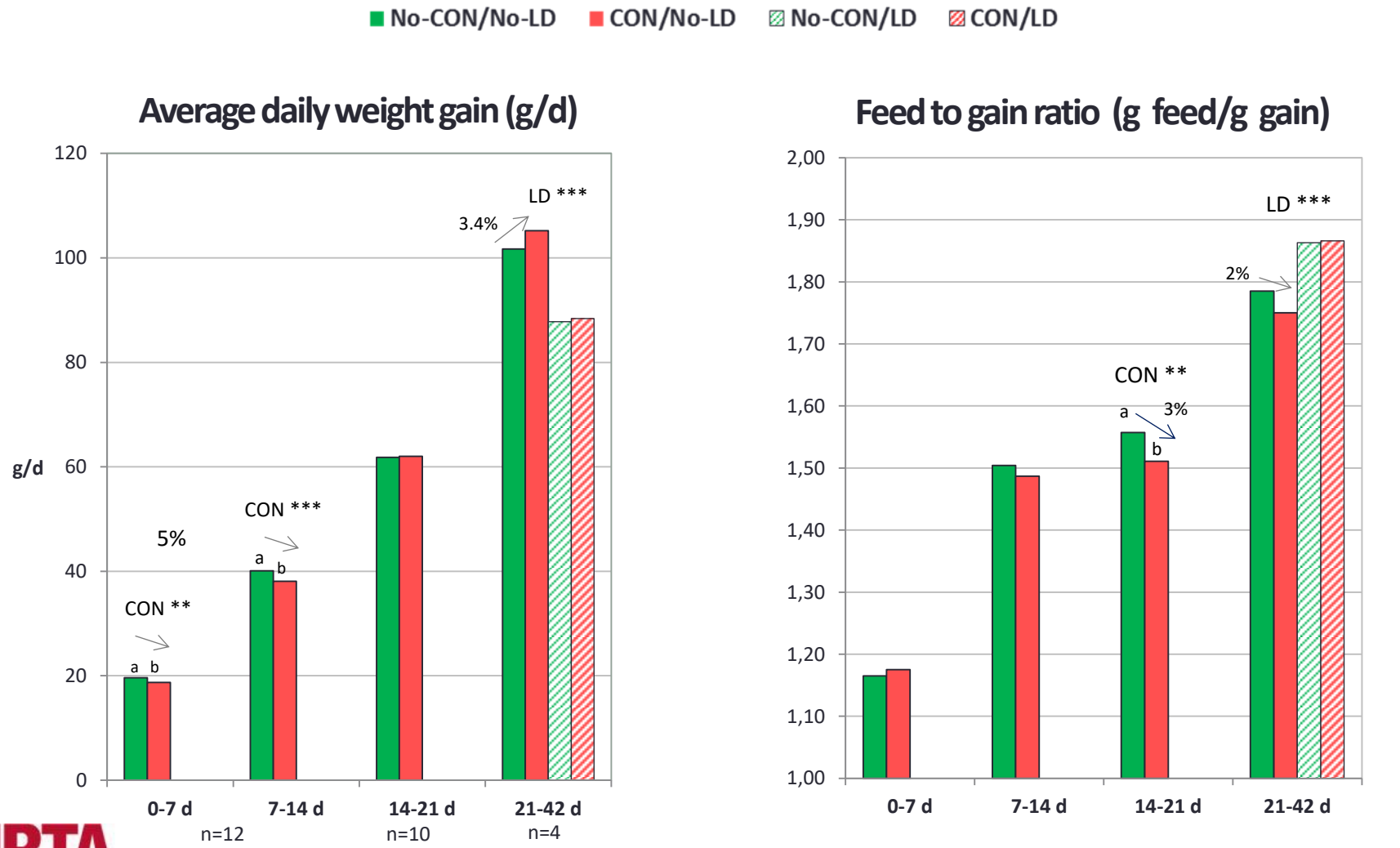
Results: performance



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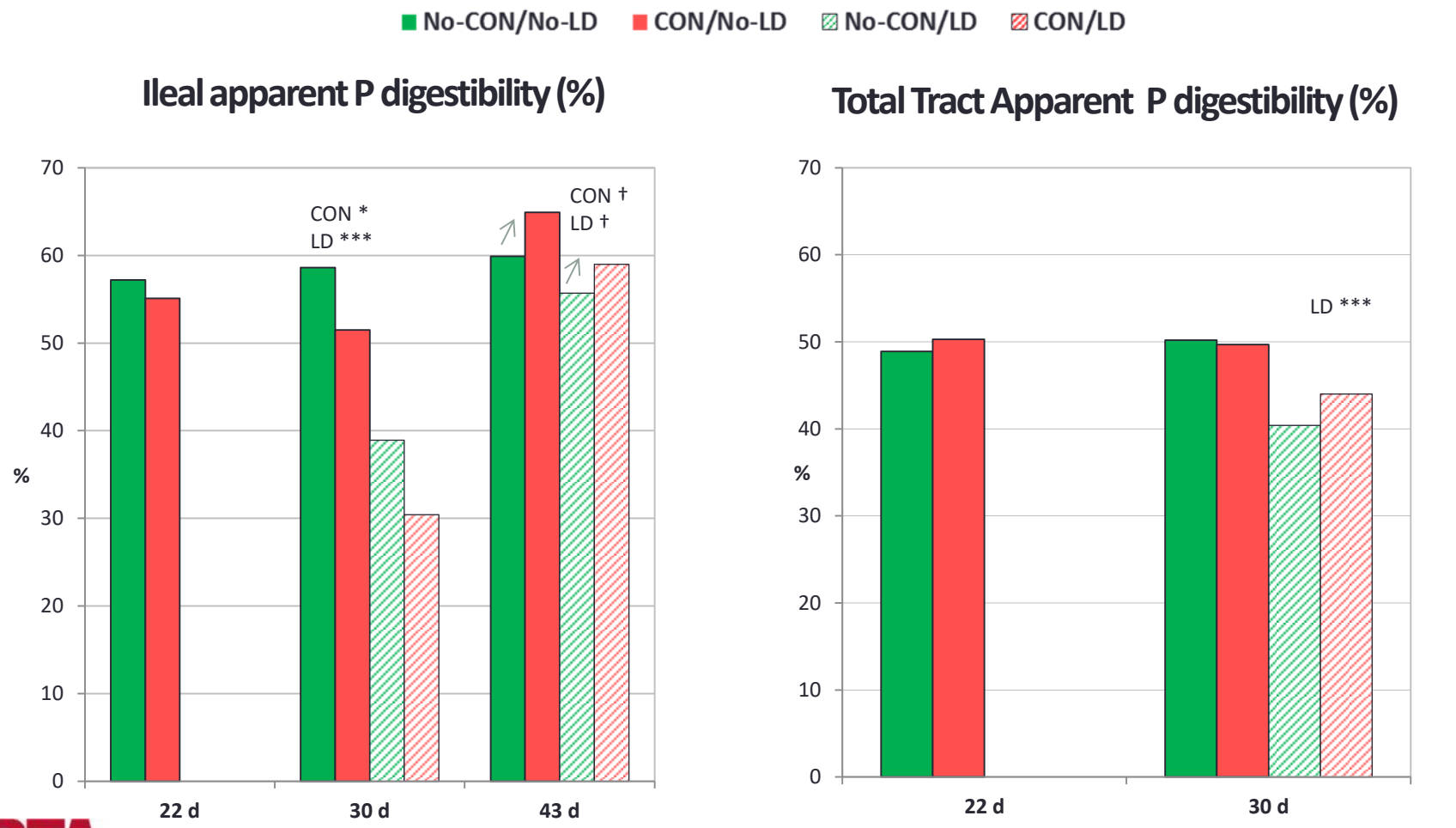
Results: P digestibility



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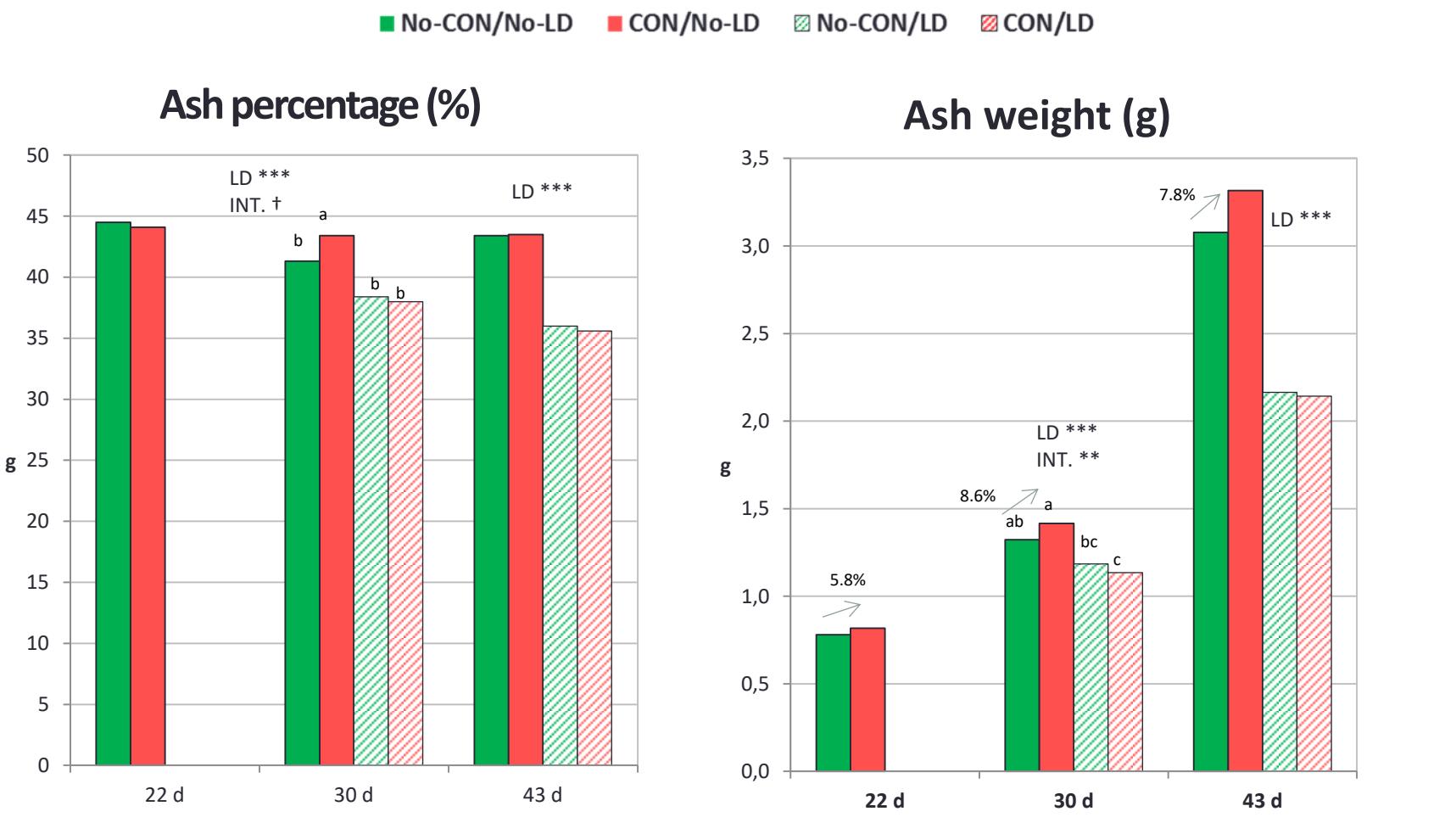
Results: tibia mineralisation



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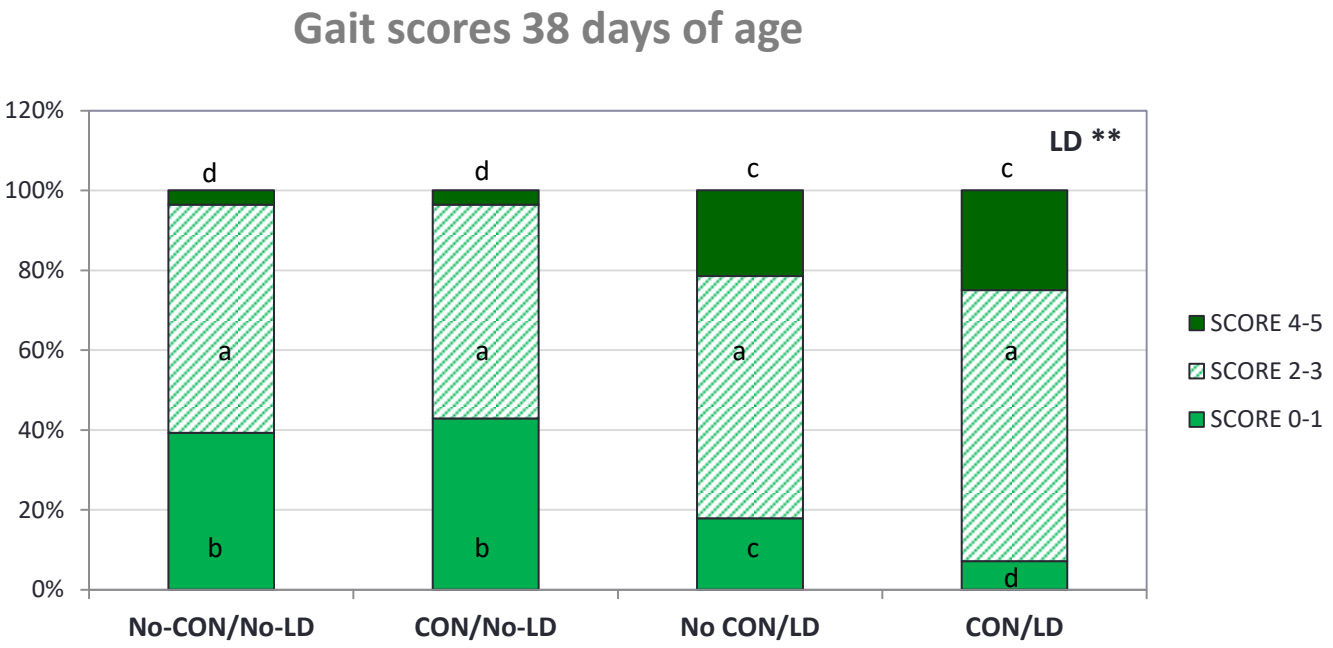
Results: welfare measurements (group housed)



0=normal to **5**=incapable of sustained walking on its feet

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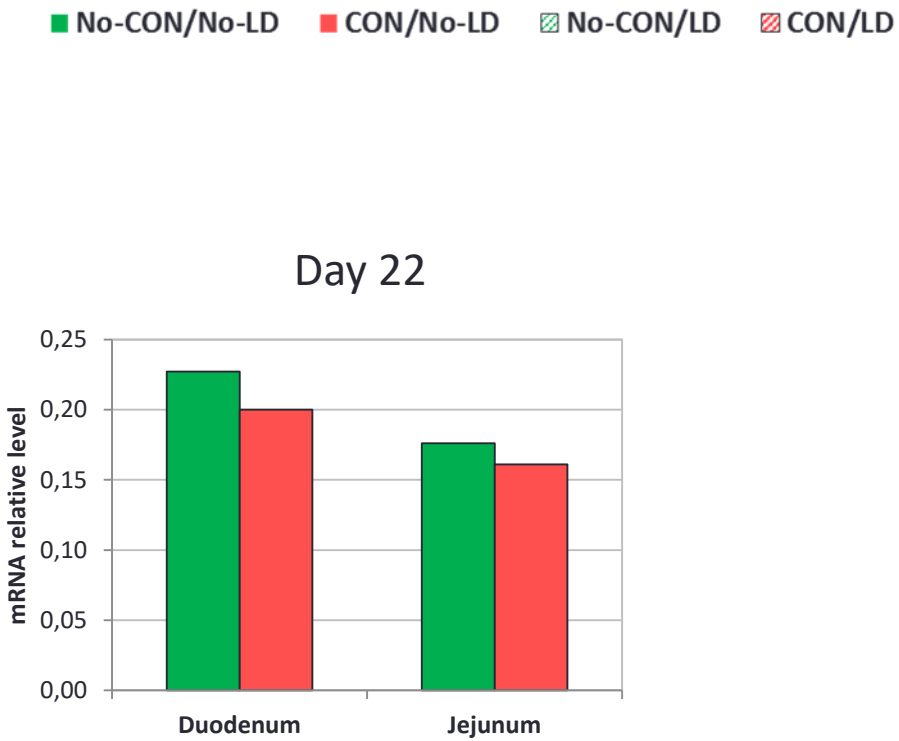
Results: expression of Type IIb Sodium Phosphate Cotransporter (SLC34A2) in duodenum and jejunum (Rt-PCR)



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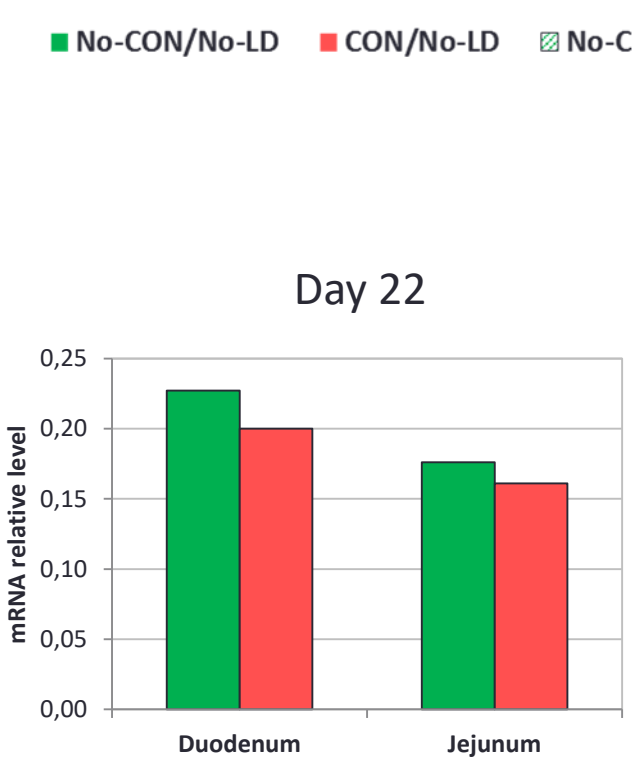

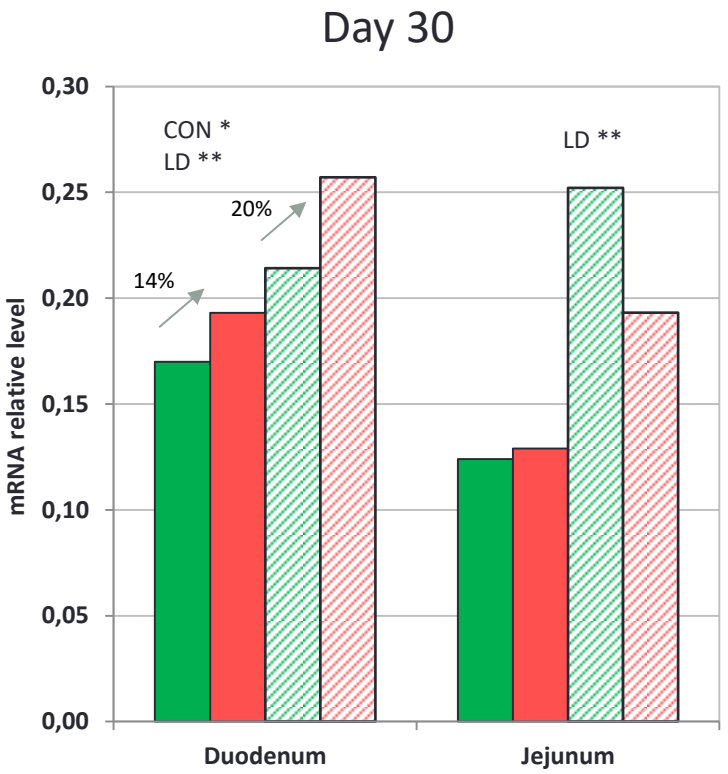

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Summary:

- P nutritional conditioning worsened ADG from 0-14d but resulted in overall numerical improvement from 21-42d.
- Improved F:G in 3rd wk and resulted in numerical improvement from 21-42d.
- P deficiency from 21-42d impairs performance and conditioning did not compensate it.
- Tendency for a positive effect of P conditioning on AID of P at day 43.
- P conditioning tended to improve bone mineralisation (total tibia ash).
- P conditioning did not affect gait score, but late deficiency ↑ gait score.
- Both CON and LD increased the expression levels of Type IIb sodium-phosphate cotransporter in duodenum.
- Late deficiency also increased Type IIb Na-P cotransporter expression in jejunum.

Conclusion:

Although not conclusive, results suggest a positive effect of P nutritional CON on performance and bone mineralisation of broiler chickens. LD did not highlight the possible advantages of CON.

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