Improvement in skeletal development of ISA-brown pullets by maternal and post-hatch feeding of omega-three fatty acids

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1. Introduction

- The egg industry is facing high incidences of osteoporosis which is associated with 20-35% of all mortality and depopulation in cage housing systems.
- The growth of cortical bone ceases by onset of lay [1].
- Medullary bone starts to be formed at sexual maturity and continues to develop over the lay cycle [1].
- Nutritional strategies aiming to minimize osteoporosis target before the onset of lay.
- Embryonic period is one of the most important parts of birds' life, which is critical for future metabolism and growth.

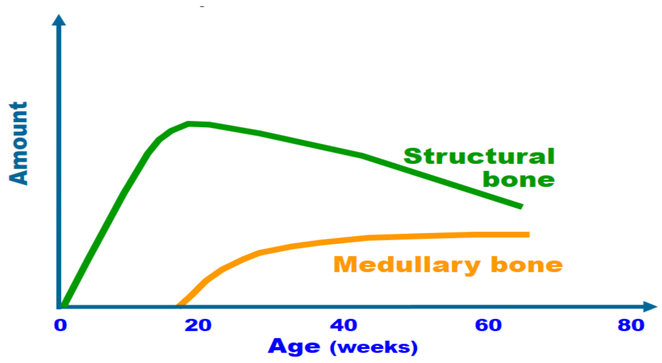


Figure 1. Bone mineral content of medullary and structural bone in laying hens over the laying phase [2].

- Omega-three fatty acids (**n-3 FA**):
  - ✓ α-linolenic (**ALA**): the precursor of other n-3 FA and can not be synthesized in body.
  - ✓ Docosahexaenoic acid (**DHA**): ALA can be converted to DHA but at low efficiency.

2. Hypothesis

Enriching breeder diets and early life diets with n-3 FA will stimulate the perinatal development of skeletal and immune systems resulting in a significant long-term improvement in productivity, skeletal health, immunity and welfare in the progeny.

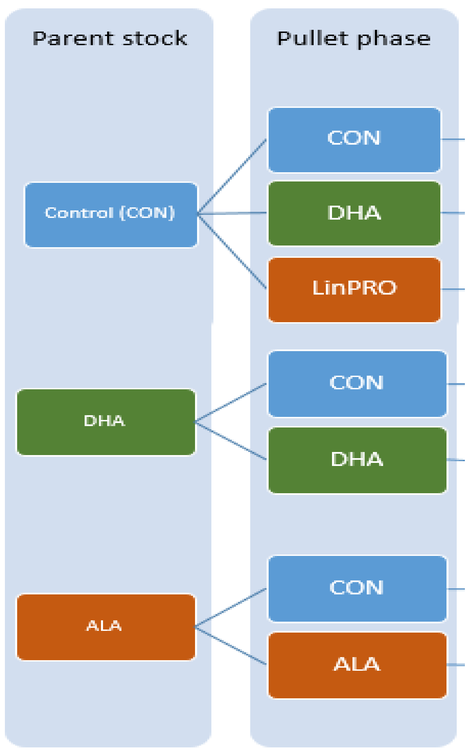
3. Materials and Methods

Maternal treatments

✓ISA brown breeders at 26 weeks of age were divided into three dietary treatments:

1. Control (**CON**)
2. **DHA**: CON + 1% of a dried micro-algae (*Aurantiochytrium limacinum*) fermentation product
3. **ALA**: CON + 2.48% of LinPro, a dry extruded product consisting of full-fat flaxseed

✓ Each treatment had 3 replicates consisting of 27♀ and 4♂.
✓ The tested diets had same amount of total n-3 and n-6:n-3 and were offered for 30-d.
✓ After confirming the deposition of n-3 eggs, eggs were collected and hatched.



Post-hatch treatments

✓ The offspring treatments were equal in total amount of n-3 and n-6:n-3.
✓ Each treatment had 6 replicates consisting of 9 pullets.
✓ Pullets were necropsied at 12 wk for tibia sampling.
- Epiphysis were separated from diaphysis.
- The medullary bone removed by scraping from the cortical part.

Analyzed parameters:

✓ Left tibia: the dried weight (DW), ash weight (AW) and % (AP).
✓ Right tibia: breaking strength as Newton (N/m2) pressure at 2 mm/sec.
✓ Data were analyzed as completely randomized design through GLIMMIX procedure of SAS.

Figure 2. Experimental layout of the post-hatch treatments.

4. Results

- There was no effect on total DW, AW and ash percentage of tibia, epiphysis and medullary.
- ALA-CON pullets had higher ash content in cortical (P = 0.045) compared to CON-CON pullets.

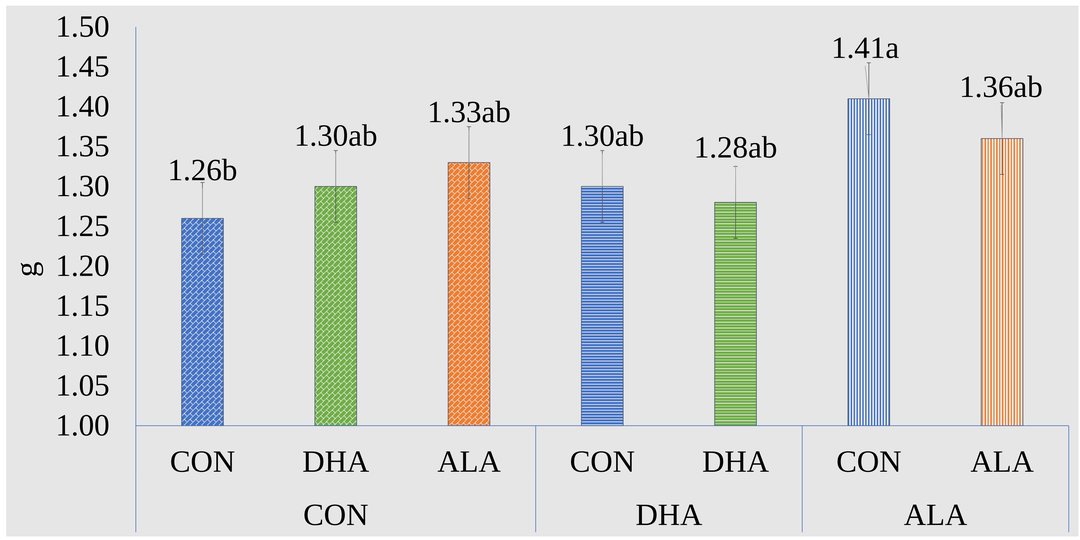


Figure 3. Ash content of cortical part of tibia in 12-wk old ISA brown pullets.

- The CON-ALA pullets had stronger tibia (P = 0.038) compared to pullets from the CON-CON and DHA-DHA group.

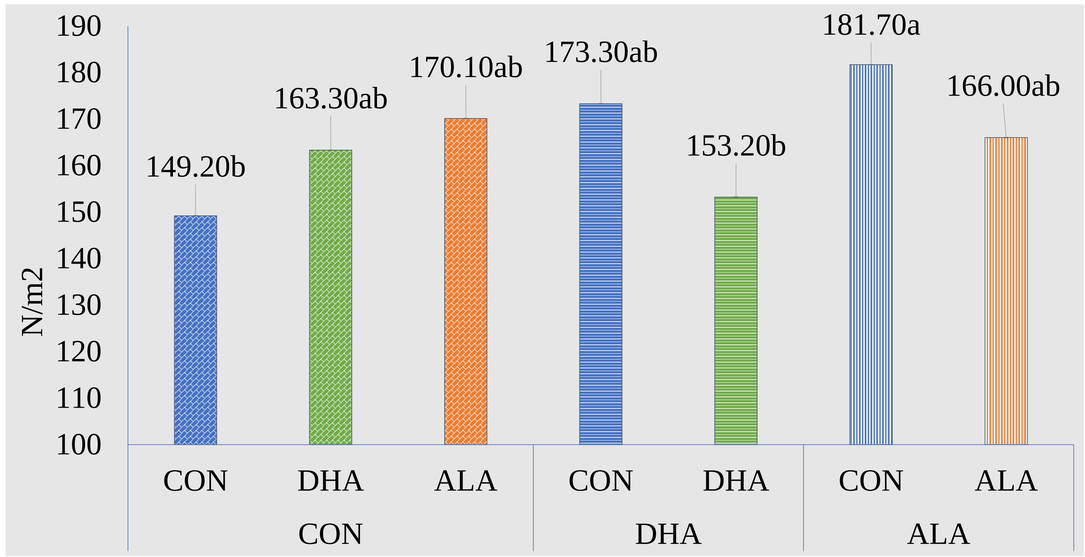


Figure 4. Tibia breaking strength in 12-wk old ISA brown pullets.

- Potential mechanism of action:
  - ✓Change in cell membrane FA profile ➡ reduced production of prostaglandin E2
  - ✓Change in cytokine secretion and expression

5. Conclusions

❖ These findings demonstrated the effectiveness of maternal feeding of n-3 FAs as more efficient feeding strategy over rearing feeding program in support of skeletal strength in young pullets.
❖ The inclusion of n-3 sources into either maternal and post-hatch diets did not improve skeletal strength.

References

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Acknowledgements

✓ Ontario Agri-Food Innovation Alliance
✓ Alltech Canada
✓ NSERC
✓ Arkell Research barn staff
✓ O & T Farms