The Effects of Incremental Levels of Omega-3 Fatty Acids from either Flaxseed Oil or Preformed Docosahexaenoic acid (DHA) on Health Indices of Laying Hens

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INTRODUCTION

- Omega-3 polyunsaturated fatty acids (PUFA), including alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), are considered essential fatty acids for poultry.
- Current research on omega-3 PUFA for laying hens has focused on level needed to enrich that are in demand by human consumers. However, a defined requirement of omega-3 PUFA has not been established for poultry.
- Lipopolysaccharide (LPS) has been widely used to model bacterial infection experimentally in animals. Studies have shown LPS challenge directly activates monocytes and macrophages to produce oxylipins such as eicosanoids.
- However, the potential anti-inflammatory effect of oxylipins derived from omega-3 PUFA after an LPS challenge remain unknown.

HYPOTHESIS & OBJECTIVES

- Hypothesis: Omega-3 PUFA can positively modulate oxylipin synthesis after an immune challenge in laying hens to strengthen immune responses.
- Objectives: Determine the optimum quantity (level) of total omega-3 PUFA from either ALA or DHA that aims to develop immunomodulatory effects in birds to order in an immune challenge elicited by LPS.

MATERIALS & METHODS

- Animals: A total of 80 Lohmann LSL-Classic (white-egg layers) will be individually housed in cages and divided into 1 of 8 dietary treatments (10 hens per treatment).
- Diet: Total omega-3 in diet (% by weight)
  - Flaxseed oil (FO)
  - Preformed DHA

Sample Collection and Measurements:
- Performance (daily feed intake, body weight, egg weight, egg production, feed conversion ratio) were recorded.
- At day 56:
  - Total Fatty Acids by GC-FID of methyl esters
  - At termination:

RESULTS

- No significant differences (P > 0.05) were observed in performance (Table 1) and plasma biochemistry (Data not shown).
- As shown in Table 2, increased amount of omega-3 fatty acids was found in eggs.

DISCUSSION & CONCLUSIONS

- The highest level of DHA enrichment in eggs was achieved at 0.4% for FO and 0.8% for DHA. The deposition of DHA reached a plateau (at 0.4% flaxseed oil) with further increase in dietary ALA levels, possibly due to the low conversion efficiency from ALA to DHA in poultry and low activities of rate limiting desaturase and elongate enzymes respectively.
- Total omega-3 fatty acids were increased whereas total omega-6 fatty acids were decreased in egg yolk, liver and plasma, indicating that the synthesis of omega-3 and omega-6 fatty acids competes the enzymes between each other. LPS-induced reduction in liver EPA, plasma EPA and DHA could possibly be due to the decreased of EPA and DHA were oxidized to anti-inflammatory oxylipins.
- Total oxylipins derived from AA decreased whereas those derived from DHA and EPA increased, with the incremental level of total omega-3 fatty acids.
- In summary, dietary omega-3 PUFA influenced deposition of various components of fatty acids in plasma, liver and yolk. Furthermore, LPS challenge modulated certain oxylipins.

REFERENCES


ACKNOWLEDGEMENTS