

Concurrent Session 7: Comparative Nutrition – Production animals relevant to human nutrition

Incorporation of omega 3 and omega 6 fatty acids into the diet of chickens: how long do they need to be fed to effect changes in intermediary metabolism?

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Background – The role of dietary fatty acids (FA) and their subsequent effects on metabolism has received considerable attention in mammalian species. It is becoming increasingly clear that fatty acids have metabolic consequences over and above their influence on energy density of the diet. Recent studies have linked changes in the fatty acyl composition of the cell membrane, induced by variation in the dietary fat profile, to alterations in both lipid and glucose metabolism (1,2). These diet-induced changes have effects on insulin action, glucose transport and enzyme activity that regulate triglyceride and fatty acid synthesis, factors that ultimately influence protein and lipid deposition in animals. However, there are few studies that have identified the duration of dietary feeding that is required for FA to exert changes in metabolism and carcass composition.

Review – To determine the time required to orchestrate both morphological and physiological responses of broiler chickens fed different sources of fatty acids: fish oil (n-3 FA); sunflower oil (n-6 FA); edible tallow (saturated FA). Fish oil, sunflower oil or tallow was added to the basal diet at a concentration of 50 g/kg. Growth rates, feed conversion efficiencies, carcass composition and circulating metabolite concentrations were calculated on weeks 5, 6 and 7. In addition, the respiratory quotient (RQ) was assessed on weeks 4, 5, 6 and 7 to determine any change in substrate oxidation over time. There was no difference in RQ for the three dietary groups at week 4, with all groups oxidizing similar proportions of carbohydrate and lipid. However, birds consuming the n-3 and n-6 FA diets oxidized a significantly higher ($P>0.05$) proportion of lipid than carbohydrate at weeks 5 and 6 compared to those birds fed tallow and this pattern extended to week 7. Consistent with the higher proportion of lipid oxidation, the fish and sunflower oil dietary groups also had lower circulating concentrations of triglycerides and cholesterol with the greatest reduction for these two metabolites occurring at week 7. Feed conversion efficiency and final breast muscle mass was improved by feeding birds sunflower oil compared to feeding birds either fish oil or tallow. Birds fed fish oil had lower abdominal fat pad mass at weeks 5, 6 and 7 compared to birds consuming either tallow or sunflower oil.

Conclusions – The data indicate that omega 3 and omega 6 FA have a differential effect on broiler performance and alter both energy utilization and metabolite concentrations with subsequent effects on carcass composition. Fish oil (n-3 FA) is more effective than either sunflower oil (n-6 FA) or tallow (saturated FA) at reducing body fat whereas sunflower oil is more effective in improving breast muscle mass and feed conversion efficiency than either fish oil or tallow. Most changes in carcass composition and broiler performance occur after six weeks of feeding these FA, although significant changes in both energy utilization and endocrine status occur after 5 weeks.

References

1. Newman, RE, Bryden, WL, Fleck, E, Ashes, JR, Buttemer, WA, Storlien, LH Downing JA. Dietary n-3 and n-6 fatty acids alter avian metabolism: metabolism and abdominal fat deposition. *Br J Nutr* 2002; 88:11-18.
2. Newman, RE, Storlien, LH, Bryden, WL, Kirby, AC Downing JA. Dietary n-3 and n-6 fatty acids alter avian glucose metabolism. *Br Poult Sci* 2005; 46:104-113.