Dietary n-3 and n-6 fatty acids alter the molecular species profile of avian breast muscle phospholipids

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We have previously shown that dietary n-3 and n-6 polyunsaturated fatty acids (PUFA) reduce abdominal fat pad mass, plasma triglycerides and cholesterol in broiler chickens when compared to feeding saturated fatty acids (1). These changes may be a consequence of alterations in the fluidity of the plasma cell membrane composition (2) and this in turn may influence processes involved in energy metabolism. We investigated the effects of these dietary fats on the distribution of subclasses of choline (PC) and ethanolamine (PE) phospholipids in the breast muscle of these same broilers.

Day-old broiler chickens were reared in a brooder and fed a commercial starter diet for three weeks. They were then randomly divided into three groups (n = 10) and were fed the experimental diets for six weeks. The diets were isonitrogenous and contained 80 g/kg of either edible tallow sunflower oil or fish oil giving diets enriched in saturated fatty acids, n-6 PUFA or n-3 PUFA respectively. At end of feeding, samples of breast muscle were taken and later analysed for phospholipid molecular species.

Supplementation with the different fatty acids (FA) had no effect on the distribution of phospholipid subclasses. Sunflower oil and tallow resulted in a similar molecular species profile. For the diacyl PC phospholipids the principal species were 16:0-18:1(n-9) and 16:0-18:2(n-6) whereas, for the alkyl-enyl PC phospholipids the predominant species were 16:0-18:1(n-9) and 16:0-20:4(n-6). Of the diacyl PE phospholipids the dominant species was 18:0-20:4(n-6) and of the alkyl-enyl PE phospholipids the major species were 16:0-18:1(n-9), 16:0-20:4(n-6) and 18:0:20:4(n-6). Supplementation with fish oil significantly increased ($P < 0.01$) levels of both eicosapentaenoic acid (20:5n-3) and docosahexaenoic acid (22:6n-3) into their PC and PE phospholipids compared to the other diets. Increased n-3 PUFA incorporation was associated with decreased arachidonic acid (20:4n-6) in both PC and PE phospholipids.

Broilers fed the n- 3 and n-6 enriched diets have similar energy metabolism and this is different to tallow feeding (1). The present data indicates that membrane composition is similar for broilers fed sunflower oil and tallow but different for broilers fed fish oil. Taken together, these results suggest that changes in energy metabolism are not related to membrane phospholipid composition.

1. Newman RE, Downing JA, Bryden WL, Fleck E, Buttemer WA, Storlien LH. Dietary polyunsaturated fatty acids of the n-3 and the n-6 series reduce abdominal fat in the chicken (Gallus domesticus). Proc Nutr Soc Aust 1998; 22: 54.
2. Clandinin MT, Cheema S, Field CJ, Garg ML, Vendatraman J, Clandinin TR. Dietary fat: exogenous determination of membrane structure and cell function. FASEB J 1991; 5: 2761–2769.