Concurrent session 1: omega-3

LONG-CHAIN N-3 OILS: DOES FARMED AUSTRALIAN FISH REMAIN A BETTER SOURCE OF THE GOOD OIL THAN WILD-CATCH FISH?

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Background/Aims: Seafood contains n-3 long-chain (≥ 20 carbons) polyunsaturated fatty acids (LC-PUFA, also termed LC-n-3 oils). Humans biosynthesize only small amounts of LC-3, so they are considered semi-essential nutrients in our diet. Concern exists that compared to wild-caught seafood, farmed fish contain lower LC-3 content due to use of non-marine oil in diets. We determined current LC-3 content and composition of farmed Australian fish and also supplements, as consumers increasingly seek their LC-3 from the latter.

Methods: Lipids were extracted by standard methods with fatty acids (FA) analysed as FA methyl esters by GC and confirmed by GC-MS.

Results: We observed that two major farmed finfish species, Atlantic salmon and barramundi, have higher oil and LC-3 content than the same or other species from the wild, and remain an excellent source for obtaining substantial intake of these oils. Notwithstanding, in Australia (and New Zealand) LC-3 oil content has decreased in these two farmed species, largely resulting from the replacement of dietary fish oil with poultry oil. For Atlantic salmon, LC-3 content decreased ~30–50% between 2002 and 2013, and the n-3:n-6 ratio also decreased (> 5:1 to < 1:1). For the supplements compared, all met LC-3 specifications.

Conclusions: The development and application of new oilseeds containing LC-3 oils, and their incorporation in aquafeeds, will enable the content of these oils to be maximized in farmed seafood. Such advances can assist with: fisheries management, aquaculture nutrition, an innovative feed/food industry and ultimately towards improved consumer health.

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POTENTIAL FOR LONG CHAIN N-3 PUFA SYNTHESIS IN POULTRY: CHARACTERISATION OF THE CHICKEN, TURKEY AND DUCK ELONGASE ENZYMES

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Background/Aims: Poultry could be a useful source of non-fish derived EPA and DHA if they are capable of synthesizing these n-3 PUFA from dietary plant-derived α-linolenic acid. The ability to elongate docosapentaenoic acid (DPA; 22:5n-3) to 24:5n-3 is a crucial and limiting reaction for synthesis of DHA. We examined the activities of the chicken, turkey and duck elongase enzymes, Elov5 and Elov2.

Methods: Saccharomyces cerevisiae expressing the chicken, turkey or duck Elov2 or Elov5 were cultured in the presence of various C18-C22 PUFA substrates to determine the substrate specificity and dose response of the enzymes.

Results: The turkey and duck Elov5 activity was limited to C18 and C20 PUFA substrates. The chicken Elov5 activity was unique compared to turkey and duck as it also elongated DPA to 24:5n-3 with 20% conversion. Conversion was undetectable for turkey and duck Elov5. The duck Elov2 selectivity was broad with elongation of C18:2 PUFA substrates compared to the more restricted chicken or turkey Elov2 selectivity towards C0 and C22 PUFA substrates only. EPA dose response curves indicate that the duck Elov2 was the most efficient to catalyse the sequential elongation reaction EPA to DPA to 24:5n-3.

Conclusions: The combined activity of the chicken Elov5 and Elov2 to convert DPA to 24:5n-3 may enable chickens to synthesize more 24:5n-3 and subsequently more DHA compared with turkey and duck. However, the duck Elov2 was particularly active in elongating EPA and DPA to 24:5n-3 indicating a capability for DHA synthesis that could be exploited.

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EFFECT OF FISH OIL ON CLINICAL OUTCOMES IN RECENT ONSET RHEUMATOID ARTHRITIS

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Background/Aims: To examine the effect of a fish oil intervention on disease control and disease-modifying anti-rheumatic drug (DMARD) effectiveness in recent onset rheumatoid arthritis (RA) with follow-up analysis of the relationships between plasma levels of the n-3 fatty acids, EPA and DHA, and the same outcome measures.

Methods: We conducted a double-blind randomised controlled trial (RCT) of high dose fish oil versus control in recent onset RA treated with a rules-based drug algorithm, responsive to disease activity and toxicity. This allowed DMARD use (in fact failure of DMARDs to achieve disease control) to be a primary outcome measure along with remission. As well as the analysis by treatment group, relationships between plasma EPA and DHA and the primary outcomes were examined.

Results: Compared to the control group, the fish oil group had an increased rate of remission (HR 2.09, 95%CI: 1.02, 4.30; p = 0.04) and decreased rate of DMARD failure (RR 0.24, 95%CI: 0.10, 0.54; p = 0.006). Plasma EPA was favourably associated with time to remission (HR 1.12, 95%CI: 1.02, 1.23; p = 0.017) and time to DMARD failure (HR 0.85, 95%CI: 0.72, 0.99; p = 0.047). The HRs for DHA and the same outcomes were similar to those for EPA but not statistically significant.

Conclusions: An RCT demonstrated increased ACR remission and decreased DMARD failure in the fish oil group. Follow-up analysis was consistent with the RCT results in demonstrating favourable relationships between plasma EPA and the same outcome measures. Anti-inflammatory doses of fish oil can provide adjunctive therapy for standard drug treatment of recent onset RA.

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BIOAVAILABILITY OF FISH OIL VS KRILL OIL – INFLUENCE OF GENDER

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Background/Aims: Krill oil is an alternative source of n-3 fatty acids (FAs). There are conflicting results from the studies comparing the effects of fish oil and krill oil.

Objective: The aim of this study was to compare the true bioavailability of n-3 FAs from fish oil and krill oil in rats of both genders, using the whole body fatty acid balance method (WBFBAM).

Design: Sprague Dawley rats (36 male, 36 female) were randomly assigned to 6 groups after one week acclimatization, were fed to constant ration for 19.8 mg/g of diet) to a fish oil diet (KO: 10% fat, EPA+DHA = 19.8 mg/g of diet) or a fish oil diet (FO: 10% fat, EPA+DHA = 20.5 mg/g of diet). The faeces and whole body were analysed for fatty acid content.

Outcomes: Krill oil and fish oil supplementation led to approximately similar levels of EPA and DHA in the whole body in both genders. More than 90% of the EPA ingested was β-oxidised in both diets. More than 60% of the DHA was β-oxidised; which was significantly higher in KO than FO. The amount of DHA deposited was significantly more in KO than FO. More than 80% of docosapentaenoic acid was deposited in KO compared with 35% in FO. In contrast, less than 10% of KO was β-oxidised compared with 60% in FO.

Conclusions: The results suggested that krill oil and fish oil n-3 FAs have different metabolic fate.

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ERYTHROCYTE LONG CHAIN N-3 PUFA LEVEL IS A PREDICTOR OF BODY WEIGHT STATUS IN OLDER AUSTRALIANS

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