

An investigation of the post-prandial effects of a meal rich in long-chain omega-3 fatty acids



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Introduction

Evidence from epidemiological studies indicates that the regular consumption of oily fish may be protective against the risk of cardiovascular disease. The benefits appear to be related to the content of long-chain omega-3 fatty acids (LC n-3 PUFA), specifically eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Current dietary guidelines therefore recommend the consumption of two portions of fish per week, one of which should be oily (1), which equates to 0.45g LC n-3 PUFA per day. Although there is limited information about intakes of EPA and DHA in Scotland, recent studies show that they are consistently below recommendations (2). Further review of the dietary intake data indicates that the consumption of oily fish is sporadic and inconsistent (3) despite attempts to promote regular intake.

Several of the mechanisms involved in the development of cardiovascular disease (CVD) involve endothelial function. Post-prandial hyperlipidaemia has been linked to an increased risk of CVD (4), which is largely attributed to the transient (2-6 hour) decrease in endothelial function (5). Changes in endothelial function have also been shown to be associated with superoxide production (6), implicating oxidative stress as a possible mechanism for endothelial dysfunction. The long-term effects of LC n-3 PUFA on oxidative stress and inflammation are well established, however little is known about their immediate post-prandial effects. Identifying the possible benefits of consumption of a single meal rich in LC n-3 PUFA may provide a new perspective on which to promote dietary changes.

The aim of this pilot project was therefore to identify post-prandial changes in endothelial function, assessed by measurement of arterial compliance, and whole blood fatty acid profile in response to two test meals differing in their LC n-3 PUFA content.

Subjects and test meal

Six healthy adults were recruited to the study (three males), as defined by age 20 - 40 years and BMI 18.5 – 24.9.

| Per meal | Test | Control |
|----------------|------|---------|
| Kcal | 968 | 970 |
| Fat (% energy) | 48 | 48 |
| g LC n-3 PUFA | 8 | <0.2 |

The test meals were based on a pasta dish with either salmon (test) or ham (control) in a cream sauce. The salmon used is produced with a particularly high content of LC n-3 PUFA.

Methodology

Each subject was randomly assigned to receive each of the two meals on separate days at least three days apart. Arterial compliance was assessed at fasting baseline and post-prandially at 30, 60, 120 and 180 minutes by pulse wave velocity (PWV) and augmentation index (AIx) using a portable vicorder monitor (Skidmore Medical, UK). Whole blood fatty acid profile was assessed from analysis of a finger prick blood sample by the Omega Bloodcount Test™ (7) at fasting baseline and at 180 minutes. Data was analysed using paired t-test and repeated measures ANOVA.

References:

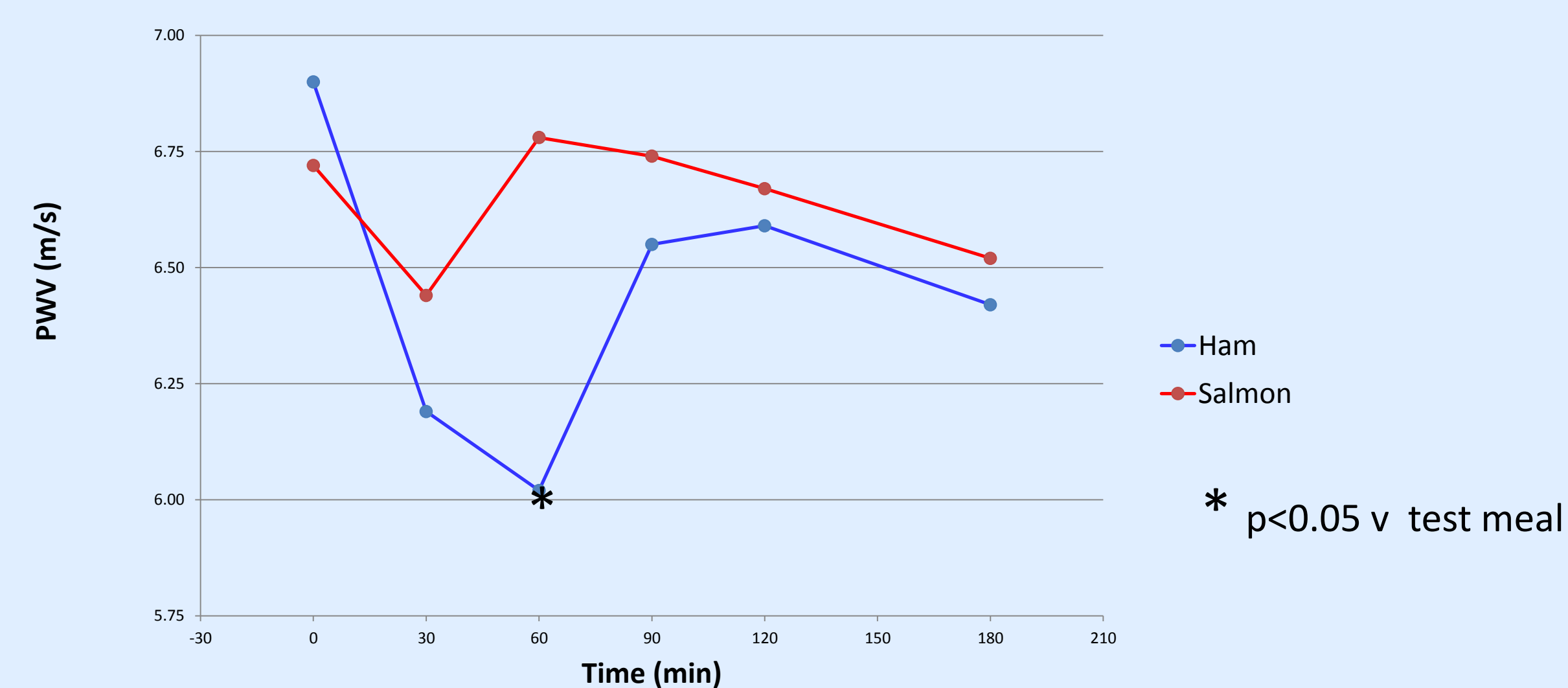
- (1) Scientific Advisory Committee on Nutrition (SACN). 2004.
- (2) O'Callaghan and McKenzie. FASEB Abstract 2010.
- (3) McKenzie. Unpublished data 2010
- (4) Alipour et al. Atherosclerosis Supplements 2008; 9: 39-44
- (5) Wallace et al. Int. J. Cardiol. 2010; 64: 389-403
- (6) Bae et al. Atherosclerosis 2001; 155: 517-523
- (7) Bell et al. FAND abstract 2009
- (8) Webb et al. Hypertension 2008; 51(3): 784-90

Results and discussion

There were no significant changes in PWV and AIx from baseline or between the meals, except that PWV at 60 mins was significantly lower for the control meal ($p < 0.01$) than baseline or between meals (Fig 1). Although this outcome was influenced by the data from one subject, it may indicate the possibility of an immediate post-prandial decrease in PWV in response to the control meal.

Overall, the patterns of change in PWV (Fig 1) and AIx appeared to differ and warrant further investigation. Apparent effects of the control meal may in fact be due to the nitrate composition of the ham, which has the potential to influence arterial compliance (8).

Fig 1 Pulse-wave velocity (PWV)



Whole blood fatty acid levels showed significant responses to the test diet 180 minutes post-prandially. The ratio of Arachidonic acid to EPA (ARA/EPA), an indicator of CVD risk, decreased significantly following consumption of the test meal (Fig 2). This was accompanied by a significant increase in the amount of LC n-3 PUFA as a percentage of total n-3 PUFA (Fig 3). Total n-3 PUFA acid levels remained stable with the control meal, despite the high intake of fat, indicating that the changes were due to the influx of EPA and DHA from the test meal.

Fig 2 ARA/EPA

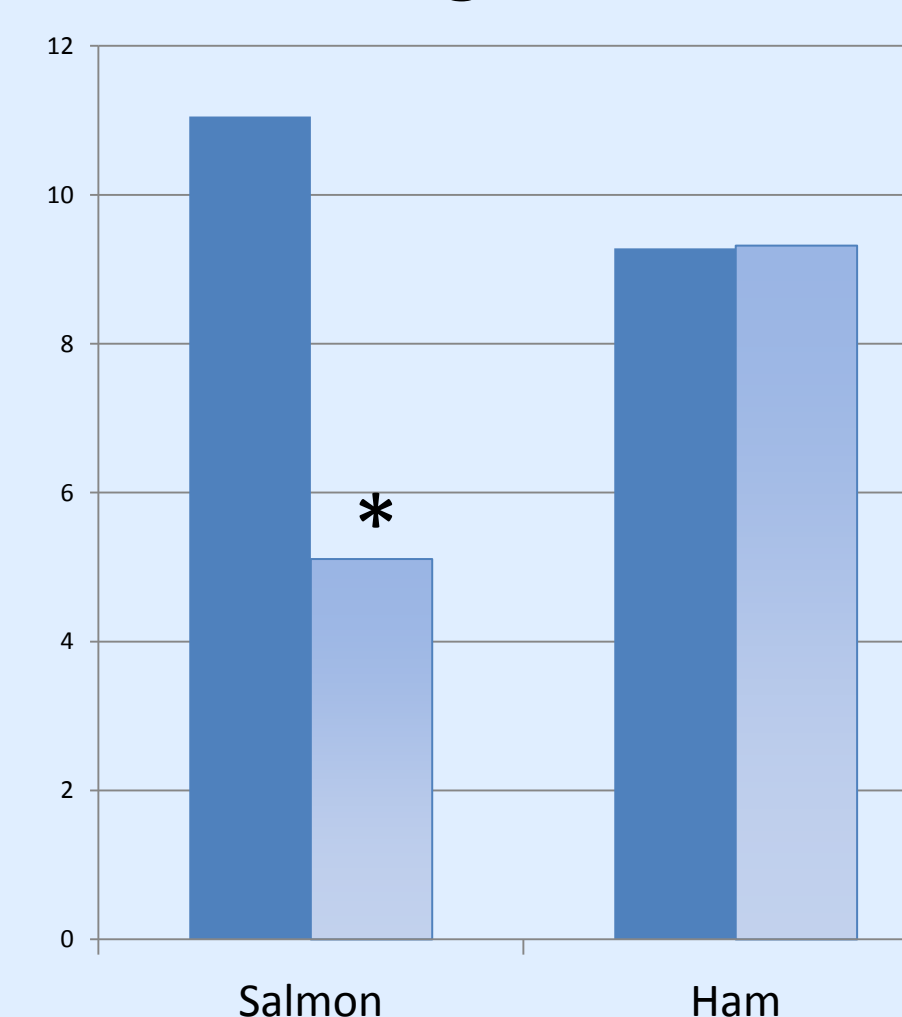
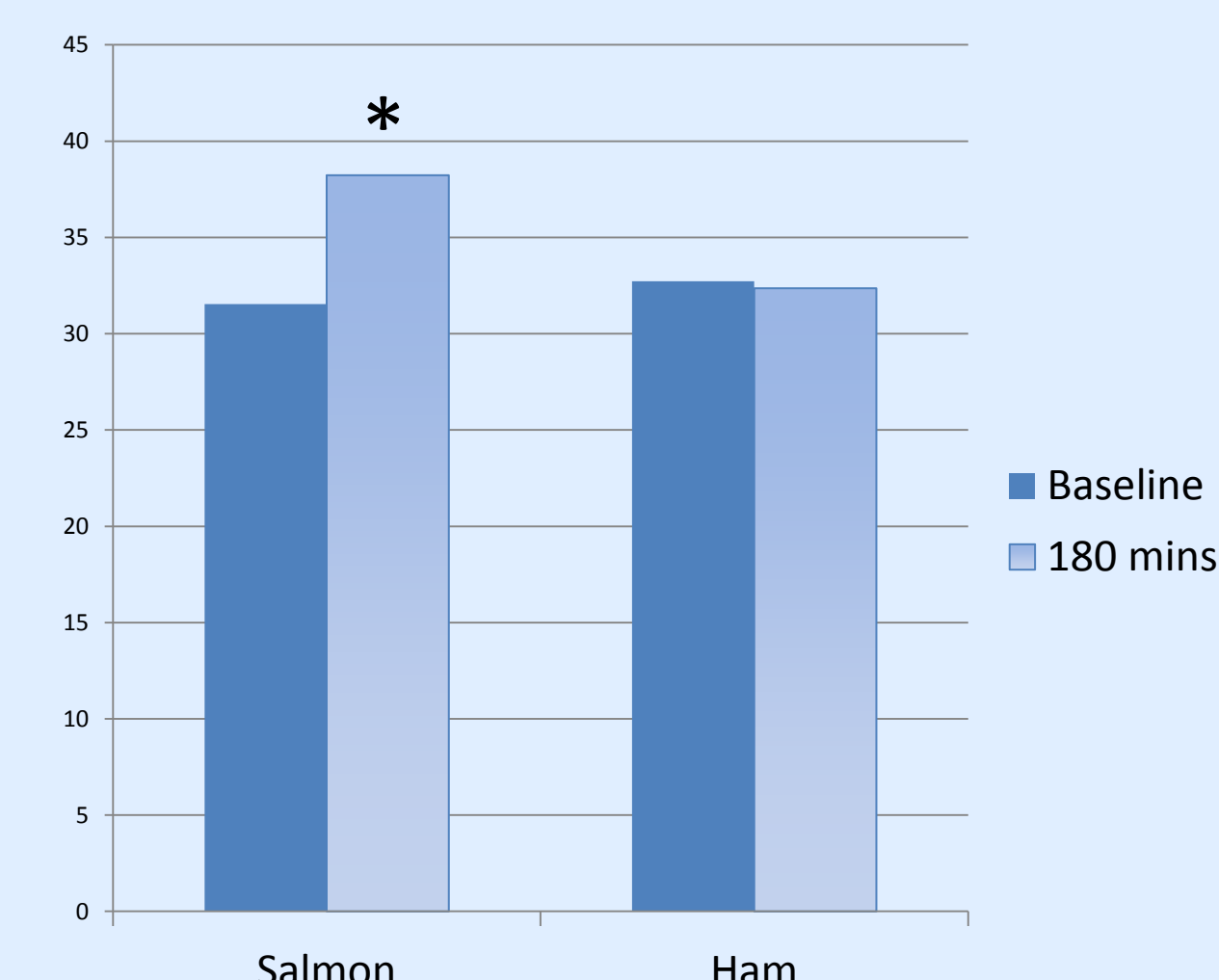


Fig 3 % LCn-3/total LC



Conclusions

This pilot project shows that consumption of a meal rich in LC n-3 PUFA had immediate post-prandial effects on the fatty acid profile of the blood that may influence changes in arterial compliance. Further development of the methodology is required to determine the most appropriate test meal. Future research, monitoring responses in a larger group of subjects over a more extensive post-prandial period, will also investigate the parameters involved in the mechanism indicated for the possible effects of LC n-3 PUFA on CVD risk including antioxidant profile and measures of oxidative stress.

The salmon for this project was generously donated by Scottish supported by Scottish Sea Farms Ltd, Oban Euan Paterson was supported by a Vacation Scholarship awarded by Medical Research Scotland