Posters

Alternate sources of long-chain omega-3 oils
PD Nichols, P Mansour, S Robert, D Frampton, S Blackburn, J Petrie, S Singh, A Green
CSIRO Food Futures Flagship and CSIRO Marine and Atmospheric Research, Hobart, TAS
CSIRO Plant Industry, Canberra, ACT

Background - Long-chain (≥C20) omega-3 polyunsaturated fatty acids [LC-PUFA, e.g. EPA, 20:5(n-3) and DHA, 22:6 (n-3)] have health benefits against coronary heart disease, inflammatory diseases such as rheumatoid arthritis, hypertension and other disorders, and are essential for infant nutrition (e.g. brain and retina development). Omega-3 LC-PUFA also have beneficial effects against some cancers as well as various mental disorders such as schizophrenia, ADHD and Alzheimer’s disease. Presently fish oils are the main commercial source of the beneficial omega-3 LC-PUFA. However, global fish stocks have been reported to be unsustainable, indicating a need for new sustainable and commercially viable sources of such oils. In addition, fish do not synthesise these oils, rather microalgae and other marine microorganisms (e.g. thraustochytrids and some bacteria) are the primary source of omega-3 LC-PUFA which are incorporated in higher marine animals, and ultimately in humans through consumption of seafood.

Design - A strategic research program to isolate and characterize omega-3 LC-PUFA producing marine microorganisms and their genes, and to transfer the genes to model and crop plants has been designed to allow the possibility of achieving sustainable production of new and alternate sources of omega-3 LC-PUFA.

Objectives - Microalgae and related heterotrophic organisms are a renewable resource and are amenable to high density culturing in fermentors for biomass production. They are also a source of novel genes for PUFA biosynthesis which may be transferred to terrestrial crop and oil-seed plants. A cross-CSIRO Flagship project aims to isolate, characterize and transfer new LC-PUFA genes from Australian microalgae to land plants.

Outcomes - Our research has surveyed a wide range of microalgal classes for their PUFA profiles. Very recently a suite of desaturase and elongase genes have also been successfully transferred to the model plant Arabidopsis, with EPA (3.2%) and DHA (0.9 %) having been produced in oil seeds, the latter for the first time. In addition, several strains of heterotrophic microalgae have been isolated that produce high levels of omega-3 LC-PUFA (e.g. up to 60% DHA).

Conclusions - Omega-3 LC-PUFA oils from higher plants and single cell oils offer alternative sources of these essential PUFA for use in human nutrition, biomedical applications and aquaculture and other feeds.

Post prandial glucose and insulin responses to test meals and insulin sensitivity after weight loss on a very low carbohydrate diet compared to low fat high carbohydrate diets
M Noakes, PR Foster, JB Keogh, PM Clifton
CSIRO Human Nutrition, Adelaide, SA

Background - It is speculated that high fat very low carbohydrate diets (VLCARB) may impair insulin sensitivity.

Objective - To compare, under isocaloric conditions, the effects of VLCARB and low fat high carbohydrate test meals on post prandial glucose and insulin responses before and after weight loss on these dietary patterns.

Study Design - Eighty three subjects, (mean ± SD) 48 ± 8y, total cholesterol 5.9 ± 1.0mmol/L, BMI 33 ± 3kg/m² were randomly allocated to one of 3 isocaloric weight loss diets (6MJ) for 8 weeks and on the same diets in energy balance for 4 weeks. Diets were Very Low Fat (VLF) (10% fat, 3% saturated fat), Low Fat High Unsaturated Fat (HUF) (30 % fat, 6% saturated fat) and VLCARB (61% fat, 20% saturated; 4% carbohydrate). Isocaloric test meals (MTT) of the respective dietary compositions as well as a 75g oral glucose challenge (GTT) were performed over 3 hours at the beginning and end of the study on 2 separate days.

Outcomes - Weight loss was (mean ± SEM) 8.0 ± 0.6kg (n=24), 6.7 ± 0.7kg (n=22) and 6.4 ± 0.6kg (n=21) on the VLCARB, VLF and HUF diets respectively (P=0.10) and no difference in fat mass loss. There was a significant effect of diet on the test meal glucose response (P=0.016) with the VLCARB meal provoking a lower glucose response than the VLF meal (P=0.014) and the HUF meal (P=0.054). This effect was strengthened if adjustment was made for the differences in baseline insulin AUC as a covariate (P=0.005). The VLCARB meal also induced an insulin response that was substantially lower compared to HUF and VLF meals (both P<0.001).

Conclusion - Although apparent glucose tolerance did not change with weight loss on VLCARB, the insulin response to both the glucose load and the test meals was lowered suggesting improvements in insulin sensitivity.