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Hepatic lipid composition in dietary models of high iron NAFLD investigated with Synchrotron Infrared and X-Ray Fluorescence microscopy

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Hepatocytes are essential for maintaining homeostasis of mammalian iron and lipid metabolism. Serious health consequences have been linked to dysregulation of both areas. One such consequence is non-alcoholic fatty liver disease (NAFLD). Approximately 30% of individuals with NAFLD demonstrate a moderate increase in hepatic iron; however, the mechanism and metabolic consequences remain under-investigated. We assessed the metabolic consequences using mice fed either a control or high fat (HF) diet, with or without high iron. Attenuated Total Reflection Infrared Microscopy (Macro-ATR) at the Australian Synchrotron was used to investigate lipid composition and distribution, and X-Ray Fluorescence Microscopy (XRF) at the Diamond Light Source (UK) was used to determine subcellular iron concentration and distribution. Peri-portal hepatocytes of HF fed animals exhibited elevated lipid parameters, including ester and free fatty acid concentrations ~7x that of controls ($P<0.005$). The increase was seen within lipid droplets, which were primarily composed of cholesteryl esters and triglycerides. When HF livers were iron loaded, reductions in all lipid parameters were observed, with ~2.6x lower relative ester concentration ($P<0.05$) compared to HF only. Iron loaded HF peri-portal hepatocytes exhibited shorter chain lengths ($P<0.005$) and a shift in the olefinic peak (3011 cm-1) compared to HF (3007 cm-1) ($P<0.05$), suggesting the shorter chains were more polyunsaturated. Iron accumulated within mitochondria of peri-portal hepatocytes of animals fed high iron diets. Poly-unsaturated lipids are strong activators of hepatic lipid breakdown and this study suggests a role for iron in reducing the lipid burden by remodelling hepatic lipids in NAFLD.

Presenter Gender

Man

Do you wish to take part in the Student Poster Slam

Yes

Condition of submission

Yes

Students Only - Are you interested in AINSE student funding

Yes

Level of Expertise

Student

Pronouns

He/Him

Which facility did you use for your research

Australian Synchrotron

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