The Potential of Probiotics in Preventing Diet-Induced Mitochondrial Dysfunction

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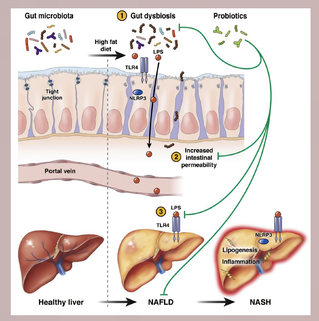
Introduction

- Diets high in fats and low in carbohydrates contribute to mitochondrial dysfunction, leading to an increase in the production of reactive oxygen species, small molecules that damage the lipids, proteins, and the DNA.
- Mitochondrial dysfunction contributes to non-alcoholic fatty liver disease (NAFLD), a condition that occurs in ≈20–40% of the adult population.
- In parallel, a healthy gut microbiome prevents NAFLD by providing short chained fatty acids to liver. Probiotic supplements could remodel the microbiota and therefore, prevent mitochondrial dysfunction and NAFLD.



Objectives and Hypothesis

- **Primary objective —** To evaluate the potential of anti-inflammatory probiotics (B. Bifidum Rossel-71 and L. Helveticus) in the prevention of diet-induced liver mitochondrial dysfunction.

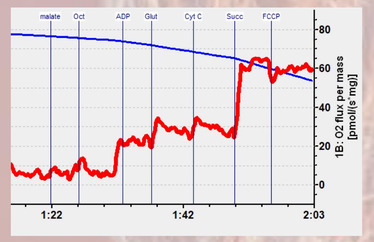
  Primary hypothesis — Animals fed probiotics will have more functional mitochondria.

- **Secondary objective —** To investigate the effects of different dietary patterns (western style and low-carbohydrate high-protein diet), on mitochondrial function.

  Secondary hypothesis — Animals fed a low-carbohydrate high-protein or a western style diet will have more dysfunctional mitochondria as compared to animals fed a control diet. Animals fed a low-carbohydrate high-protein diet will have more dysfunctional mitochondria as compared to animals fed the western style diet.

Materials and methods

- **Apolipoprotein-E knockout mice**, genetically modified to develop dyslipidemia
- **Sequential substrate addition protocol**, a method used to investigate the membrane integrity, leak and maximal respiration of the mitochondria



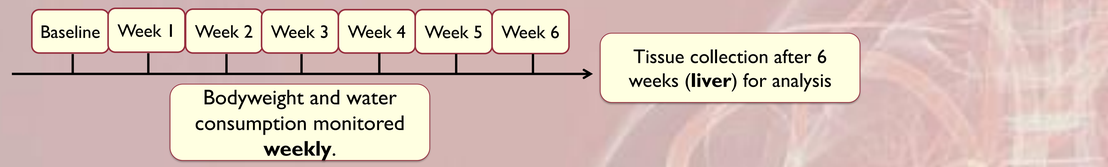
3 Diet groups

Control Diet	Western Diet	LCHP Diet
63% Carbohydrate 14% Fat 24% Protein	42% Carbohydrate 42% Fat 16% Protein	11% Carbohydrate 43% Fat 46% Protein

3 Probiotic subgroups
(billion probiotics/dose)

Control	Low-dose	High-dose
0 B/dose	0.5 B/dose	5 B/dose

9 groups total
n = 4-8 mice/group

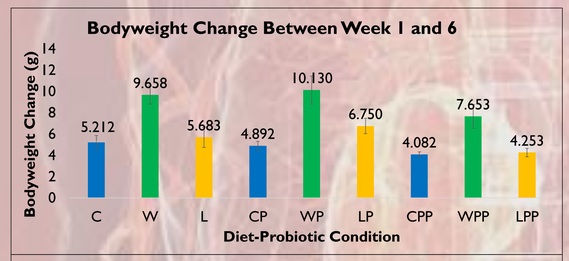


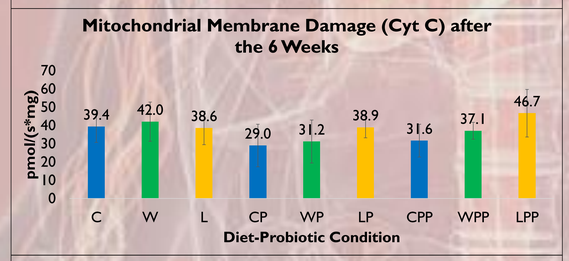
Results

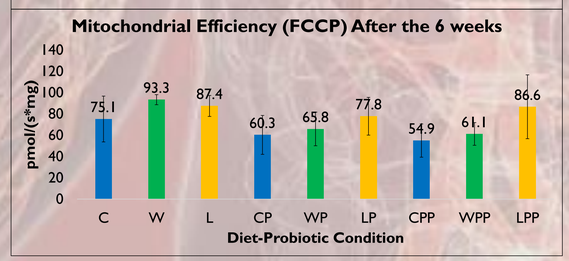
- The animals that received a **high-dose** of probiotics gained less bodyweight as compared to the groups who did not receive probiotics (**TREND**)
- The animals that consumed a **western-style** diet gained more bodyweight as compared to the animals who consumed a low-carbohydrate high-protein or control diet (**TREND**)
- Most groups receiving a **low** or **high dose** of probiotics had less membrane damage and less uncoupling as compared to groups who did not receive probiotics (**TREND**)

  Not in the low-carbohydrate high-protein diet groups
- The animals consuming a **low-carbohydrate high-protein** diet had more membrane damage and uncoupling as compared to animals consuming a western-style or control diet (**TREND**)

  Not in the groups that did not receive probiotics







Conclusions

- While a burden, NAFLD also leads to deadly metabolic conditions, including cardiovascular disease and diabetes.
- Our results show that probiotics could not only promote weight loss, but also prevent liver mitochondrial dysfunction and therefore, NAFLD.
- This project could translate into clinical recommendations but also, future research directions investigating the potential of probiotic supplements in the prevention of mitochondrial dysfunction in other organs, such as vascular smooth muscle cells.

Acknowledgements

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For further information

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