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In vitro human colonic fermentation of coffee arabinogalactan and melanoidin-rich fractions

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Introduction

Coffee beverage is a source of dietary fiber including the polysaccharide arabinogalactan and the nitrogenous brown-colored melanoidins, formed during roasting. The microbial fermentation of these high molecular weight compounds positively influence beneficial bacteria population, as well as lead to the production of short-chain fatty acids (SCFA). The acetate:propionate ratio is considered relevant to evaluate cholesterol homeostasis, as acetate serves as precursor while propionate inhibits the rate-limiting enzyme in cholesterol synthesis. Polysaccharides capable of lowering this ratio may contribute to reduce cholesterol endogenous production. Gut microbiota may also modulate cholesterol homeostasis by converting primary into secondary bile acids, which are more hydrophobic and efficient at emulsifying cholesterol, and are associated to diseases such as colon cancer, cholesterol gallstone, and Alzheimer's. Thus, decreasing this microbial conversion contributes to lower the development of several diseases.

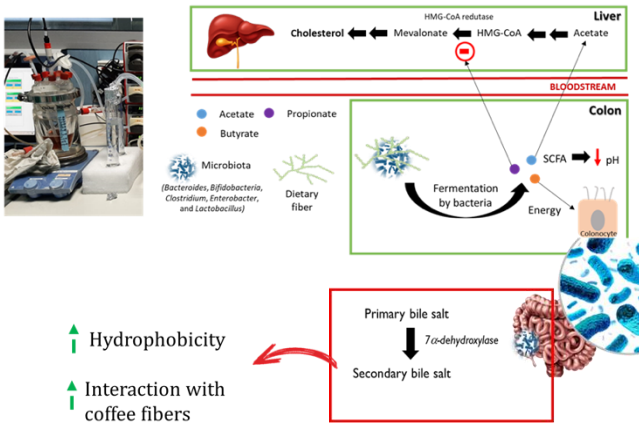

Figure 1: Fermentation molecules with impact on cholesterol metabolism

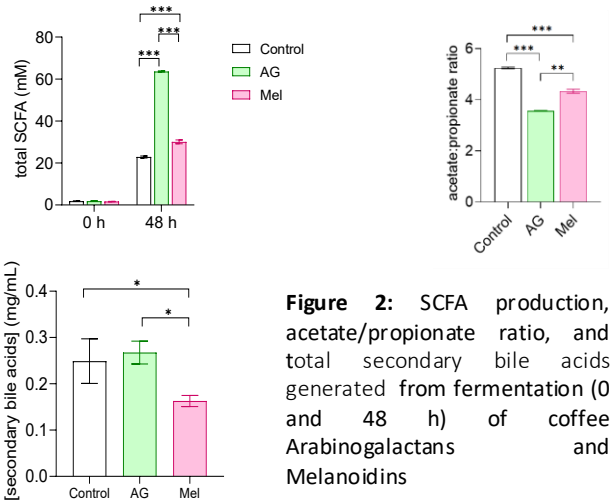

Figure 2: SCFA production, acetate/propionate ratio, and total secondary bile acids generated from fermentation (0 and 48 h) of coffee Arabinogalactans and Melanoidins

Materials/Methods

The colonic fermentability of coffee arabinogalactan (AG) and melanoidin-rich (Mel) fractions was simulated in vitro using human feces, employing simgi® (Dynamic Gastrointestinal Simulator). The fermentation degree was evaluated by the analysis of total carbohydrates. The cardioprotective potential of the ferments was evaluated by measuring SCFA and secondary bile acids production after 48h of fermentation. Phenolic compounds catabolism by microbiota and resultant antioxidant activity were also studied after 48h of fermentation.

Results/Discussion

Given its richness in carbohydrates, AG fraction was more effectively fermented (62%) than Mel fraction (27%), resulting in a higher amount of SCFA (63 mM and 22 mM, respectively). Both AG and Mel fractions decreased the acetate:propionate ratio from 4.7 (control - absence of coffee fractions) to 2.5 and 3.5, respectively, suggesting a potential to downregulate cholesterol synthesis. The fermentation of Mel fraction led to a decrease in the microbial production of secondary bile acids, from 0.25 to 0.16 mg/mL. Microbial catabolism of phenolic compounds linked to the structure of coffee fibers generated dihydroferulic and dihydrocaffeic acids, contributing to a reducing environment.

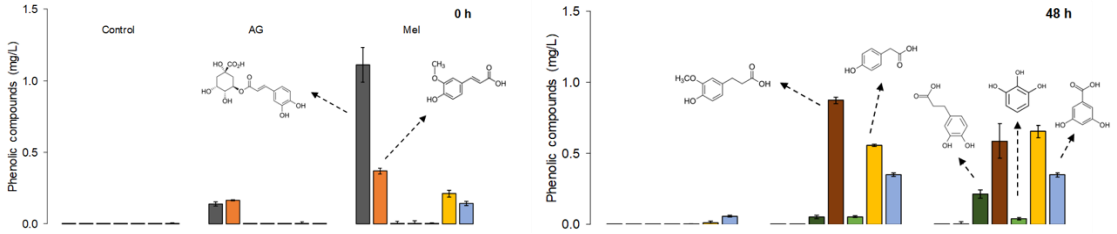

Figure 3: Phenolic compound conversion during fermentation (0 and 48 h) of coffee Arabinogalactans and Melanoidins

Conclusion/Perspectives

The *in vitro* colonic fermentation of coffee arabinogalactans and melanoidins, using human microbiota, demonstrated coffee potential to positively affect gut health and to modulate metabolic processes related to cholesterol and bile acid homeostasis.

- ✓ SCFA production was higher upon fermentation of AG fraction when compared to Mel
- ✓ Secondary bile salt content was significantly higher ($p<0.05$) in arabinogalactans sample when compared to melanoidins
- ✓ Conversion of phenolic compounds during fermentation can impact on antioxidant activity in gut

References:
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