Prebiotic inulin and resistant starch mixture-specific effect on distal colonic fermentation and metabolic health

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Abstract

Background: Metabolic issues such as obesity, diabetes and dyslipidemia have increased substantially over the past decades. Infusions of the short-chain fatty acid (SCFA) acetate in the distal colon improved metabolic parameters in men. Here, we hypothesized that combining rapidly and slowly fermentable prebiotic/fiber mixes will enhance distal colonic acetate production and improve metabolic health.

Methods: In vitro gut model studies showed that certain mixes yielded high distal colonic acetate production. Subsequently, lean and prediabetic overweight/obese men were included in two randomized crossover studies. In one study, participants consumed long-chain inulin+resistant starch (IN+RS), IN or maltodextrin (PLA) prior to a clinical investigation day. The second trial studied B-glucan+RS (BG+RS) versus BG and PLA. Breath hydrogen, indirect calorimetry, plasma metabolites/hormones were assessed during fasting and postprandial conditions. Gut microbiota composition and SCFA were also determined.

Results: In lean men, IN+RS increased breath hydrogen and fasting plasma butyrate, which was accompanied by increased energy expenditure, carbohydrate oxidation and PYY and decreased postprandial glucose concentrations (all $P<0.05$) compared to PLA. In prediabetic men, IN+RS increased plasma acetate compared to IN or PLA ($P<0.05$), but did not affect metabolic parameters. BG+RS increased plasma butyrate compared to PLA ($P<0.05$) in prediabetic men, but did not affect other fermentation/metabolic markers in both phenotypes. IN+RS induced more pronounced shifts in fecal microbiota versus BG+RS; shifts were individual-specific.

Conclusion: Administration of IN+RS the day prior to investigation improved metabolic parameters in lean but not in prediabetic individuals, demonstrating that effects were phenotype- and mix-specific. No effects were found for BG+RS, indicating addition of the prebiotic IN to the RS was essential to the effect. Longer-term consumption is anticipated to change the microbiota, therefore, such a study is being prepared to determine whether long-term changes in fermentation patterns can be directly related to changes in human energy and substrate metabolism in overweight/obese individuals.