



## Applied nutritional investigation

## Hydrogen-rich water upregulates fecal propionic acid levels in overweight adults

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The intricate relationship between the gut microbiota, its metabolites, and human health has garnered significant attention in recent years because of its potential role in the development of many diseases [1]. Among the various metabolites produced by the microbiota, a group of organic acids, known as short-chain fatty acids (SCFAs), has emerged as key regulators of host energy metabolism. These saturated aliphatic organic acids are produced through the bacterial fermentation of dietary fibers, with acetic acid, propionic acid, and butyric acid comprising 95% of the SCFA pool [2]. Interestingly, different SCFAs can elicit distinct local and systemic metabolic responses throughout the body [3]. Extensive scientific evidence has underscored the potential significance of increasing SCFA levels in the prevention and treatment of various conditions, leading to research exploring dietary interventions to enhance SCFA production. Preclinical and clinical studies have found that hydrogen gas has emerged as a promising agent for influencing gut microbial biology, among other interventions. The consumption of hydrogen-rich water (HRW) has been found to modulate colonocyte metabolism in mouse models [4], promote the growth of

beneficial bacteria in rats [5], and elevate total serum levels of SCFAs in overweight individuals [6]. However, it remains unclear whether hydrogen intake has any effect on the specific stool profiles of individual SCFAs. In this study, we conducted a secondary analysis of a previously completed, medium-term, randomized controlled trial involving HRW, using an advanced method to assess fecal levels of acetic acid, propionic acid, and butyric acid in overweight adults.

This report includes a total of 10 middle-aged overweight individuals (five women), with an average age of  $44.5 \pm 13.2$  y and a body mass index of  $28.3 \pm 2.1$  kg/m<sup>2</sup>. These participants were randomly assigned to receive either HRW 0.5 L/d, containing 3 mg of hydrogen (two men and three women), or placebo (tap water: three men and two women) for a duration of 12 wk. The levels of individual SCFAs were assessed using gas chromatography–mass spectrometry. Specifically, fecal concentrations of acetic acid, propionic acid, and butyric acid (expressed as milligrams per gram of stool) were measured using a sensitive detection method for analyzing the microbial metabolites, SCFAs, in fecal samples. The analysis was performed using a 7890B GC system coupled to a 5997A MSD mass detector on an HP-5ms column (Agilent Technologies, Waldbronn, Germany), as previously described [7]. Further information on the methodology, participant characteristics, and ethical considerations can be found elsewhere [6].

The changes in fecal concentrations of three SCFAs after the interventions of HRW and placebo are depicted in Figure 1. After a

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