



# Effect of Low FODMAP Oral Nutrition Supplements on Breath Hydrogen Response in Healthy Human Subjects

Jennifer Erickson, RD<sup>1</sup>, Renee Korczak, PhD, RD<sup>1</sup>, Stefanie Havemeier<sup>1</sup> Qi Wang, MS<sup>2</sup>, Joanne Slavin, PhD, RD<sup>1</sup>

<sup>1</sup> Department of Food Science and Nutrition, University of Minnesota, <sup>2</sup> Clinical and Translational Science Institute, University of Minnesota

## Abstract

**Purpose:** There has been increasing interest in following a diet low in fermentable oligosaccharides, disaccharides, monosaccharides and polyols (FODMAPs) for the treatment of irritable bowel syndrome (IBS). While this diet has been effective at symptom reduction, it is restrictive and patients may find it challenging to find low FODMAP products to meet their nutrient needs. The primary goal of this study was to assess the gastrointestinal (GI) tolerance of three low FODMAP oral nutrition supplements (ONS).

**Methods:** A double-blind randomized controlled crossover study was conducted with 21 healthy adults (19-32 years). Fasted subjects consumed one of four treatments at each visit, with a one week wash out period between visits. Each participant received all treatments. Treatments included three low FODMAP ONS formulas (A, B, and C) as well as a positive control consisting 5g fructooligosaccharides (FOS) mixed in lactose-free milk. All treatments were provided in 8oz servings. Breath hydrogen was measured at baseline, 1, 2, 3, and 4 hours. Subjective GI symptom questionnaires were completed at baseline, 0.5, 1, 1.5, 2, 3, 4, 12, 24 and 48 hours following treatment consumption. Baseline corrected area under the curve (AUC) was analyzed for both breath hydrogen and GI symptoms. AUC measures were compared using ANOVA analysis and if found to be statistically different ( $P < 0.05$ ), pairwise comparisons were then calculated. Significance was determined at  $P < 0.05$ .

**Results:** The positive control resulted in significantly higher breath hydrogen response compared to all three of the low FODMAP ONS beverages at 3 and 4 hours after consumption (Figure 1). There were no significant differences in GI symptom response between treatments.

**Conclusions:** All of the treatments were well tolerated in healthy participants. The low FODMAP formulas resulted in a lower breath hydrogen response compared to the positive control, and may be better tolerated in individuals with IBS. More research should be conducted in participants with IBS to better understand the GI tolerance of low FODMAP ONS in the target population.

## Background

- Irritable bowel syndrome (IBS) is a prevalent functional gastrointestinal (GI) disorder impacting 11.2% of individuals worldwide.<sup>1</sup>
- Recently, clinical research has focused on diet as a treatment for IBS, since food can be related to symptom expression in many patients.<sup>2</sup>
- Diets low in fermentable oligosaccharides, disaccharides, monosaccharides and polyols (FODMAPs) are recommended treatment options in Australia and the United Kingdom to manage the symptoms of IBS.<sup>3,4</sup>
- FODMAPs are poorly absorbed in the intestine, osmotically-active, and rapidly fermented in the colon, which can lead to pain, bloating, abdominal distention and even motility changes in individuals with irritable bowel syndrome (IBS).<sup>5</sup>
- Oral nutrition supplements (ONS) are liquid beverages formulated to improve the nutrient consumption of those individuals with either minor nutritional gaps or specific disease conditions.
- Low FODMAP ONS may provide a good source of nutrition and serve as a convenient and healthy addition to a low FODMAP diet for individuals suffering from IBS who struggle to meet their nutritional needs with conventional foods.

### Objective

To examine the gastrointestinal (GI) tolerance of three low FODMAP formulated ONS (A, B and C) in 21 healthy human subjects.

### Hypothesis

The consumption of the low FODMAP ONS would produce a lower breath hydrogen response and less GI symptoms compared to the positive control.

## Methods

**Study Design:** Double-blind, randomized controlled, crossover trial with four treatments separated by a one week washout period. Study was approved by the University of Minnesota Institutional Review Board.

**Participants:** 21 healthy subjects (11 males, 10 females) between the ages of 18-65 years with a BMI between 18.5- 29.5kg/m<sup>2</sup> participated in the study. Applicants were excluded if they were smokers, non-regular breakfast or lunch consumers, were enrolled in recent dietary intervention trial or had recent weight fluctuations. Subjects were also excluded if they had a past or existing GI disease or surgery, used enemas, laxatives, proton pump inhibitors or antibiotics within 3 months of the trial.

**Treatments:** Treatments included 3 different ONS beverages that were all formulated to be low in FODMAP concentration (A, B and C). The positive control beverage was 8 oz of lactose-free whole milk with 5 grams of fructooligosaccharides (FOS) and 2.7 grams of sucrose added to match for calories.

| Formula                                     | Calories | Carbohydrates (g) | Fiber (g) | Protein (g) | Fat (g) |
|---------------------------------------------|----------|-------------------|-----------|-------------|---------|
| Low FODMAP A                                | 170      | 19                | 3         | 15          | 4       |
| Low FODMAP B                                | 180      | 21                | 3         | 15          | 4       |
| Low FODMAP C                                | 170      | 19                | 3         | 15          | 4       |
| Lactose-free Milk + 5g FOS and 2.7g sucrose | 170      | 16                | 5         | 8           | 8       |

Table 1. Nutrient profile of the treatment beverages

### Procedure:

**24 hours prior to visit:** Participants refrained from high fiber foods and supplements, apple and pear juice, sugar alcohols, alcoholic beverages and excessive exercise.

**12 hours prior to visit:** Participants began fasting up to their arrival at testing facility.

**Study visit:** Subjects completed baseline measures of breath hydrogen and GI symptom questionnaire. Participants were then given 10 minutes to consume treatment beverage. Participants then completed the following measures:

- Breath Hydrogen:** Measured 1, 2, 3 and 4 hours post consumption
- GI Symptom Questionnaires:** Completed at 0.5, 1, 1.5, 2, 3, 4, 12, 24 and 48 hours post treatment consumption

**Statistical Analysis :** Area under the curve (AUC) was calculated for breath hydrogen and symptom response. AUC was corrected to account for each subject's baseline measurement. Means were also compared at each individual time point for breath hydrogen measures. Means were compared using paired T-Tests with statistical significance determined at  $P < 0.05$ .

## Results

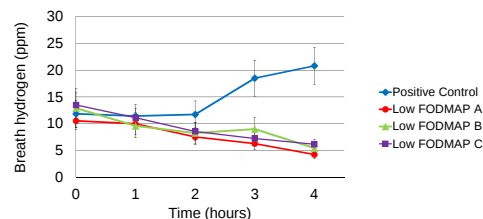


Figure 1. Change in breath hydrogen concentration following consumption of treatment beverage

- None of the three low FODMAP ONS produced an increase in breath hydrogen production in the four hours following consumption.
- Significant difference in breath hydrogen at 3 and 4 hours post consumption between positive control and all low FODMAP formulas ( $P=0.003$ )

## Results Continued

|                            | Positive Control | Low FODMAP A | Low FODMAP B | Low FODMAP C |      |         |
|----------------------------|------------------|--------------|--------------|--------------|------|---------|
| Symptom                    | Mean             | Mean         | Mean         | Mean         | SE   | P value |
| Gas/bloating               | -2.42            | -5.89        | 4.03         | -5.83        | 3.73 | 0.21    |
| Nausea                     | -6.07            | -4.25        | -0.77        | -4.42        | 3.94 | 0.81    |
| Flatulence                 | -1.02            | -4.49        | 2.99         | 1.23         | 4.04 | 0.59    |
| Diarrhea/loose stools      | 2.67             | -1.13        | 0.50         | 0.95         | 1.79 | 0.52    |
| Constipation               | 0.02             | -1.42        | 1.36         | 0.05         | 1.32 | 0.54    |
| GI rumbling                | -4.26            | -9.64        | -11.20       | -5.77        | 5.81 | 0.82    |
| GI cramping                | -2.18            | 0.07         | -1.69        | -1.32        | 2.02 | 0.88    |
| Composite GI symptom score | -10.92           | -26.24       | -4.82        | -13.40       | 9.91 | 0.48    |

Results presented as Mean (95% CI)

Table 2. AUC measurements of GI symptoms following consumption of various low FODMAP oral nutritional supplements and positive control (baseline- 48 hours)

## Conclusions

- All of the treatments were well tolerated in healthy adults, as no severe GI symptoms were reported during the 48 hours following consumption of any treatment.
- None of the low FODMAP formulas produced a rise in breath hydrogen, while the positive control elicited a steady rise over the 4 hours post consumption.
- This study was conducted on healthy human subjects as opposed to subjects suffering from IBS, who may benefit from following a low FODMAP diet.
- Based on previous findings<sup>6</sup>, we would anticipate that the low FODMAP formulas would be well tolerated in individuals with IBS, due to the lack of rise in breath hydrogen although additional research should be conducted to confirm.



## References

- Lovell RM, Ford AC. Global prevalence of and risk factors for irritable bowel syndrome: a meta-analysis. *Clin Gastroenterol Hepatol*. 2012;10(7):712-721.e4. doi:10.1016/j.cgh.2012.02.029.
- Chey WD. Food: The Main Course to Wellness and Illness in Patients With Irritable Bowel Syndrome. *Am J Gastroenterol*. 2016;111(3):366-371. doi:10.1038/ajg.2016.12.
- Gastrointestinal Expert Group Therapeutic Guidelines Limited. Therapeutic guidelines: Gastrointestinal. 2011.
- National Institute of Health and Care Excellence. *Irritable Bowel Syndrome in Adults: Diagnosis and Management*. London: NICE; 2015. <http://www.nice.org.uk/guidance/cg61/chapter/1-recommendations>. Accessed August 4, 2016.
- Gibson PR, Shepherd SJ. Evidence-based dietary management of functional gastrointestinal symptoms: The FODMAP approach. *J Gastroenterol Hepatol*. 2010;25(2):252-258. doi:10.1111/j.1440-1746.2009.06149.x.
- Magge S, Lembo A. Low-FODMAP Diet for Treatment of Irritable Bowel Syndrome. *Gastroenterol Hepatol (N Y)*. 2012;8(11):739-745. <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3966170&tool=pmcentrez&rendertype=abstract>.

## Acknowledgements

Nestle Health Science provided the research funding necessary to conduct this research project. Thank you to Hannah Paruzynski who were helped facilitate the study visits.