

## Gastrointestinal effects of bran: a MRI study

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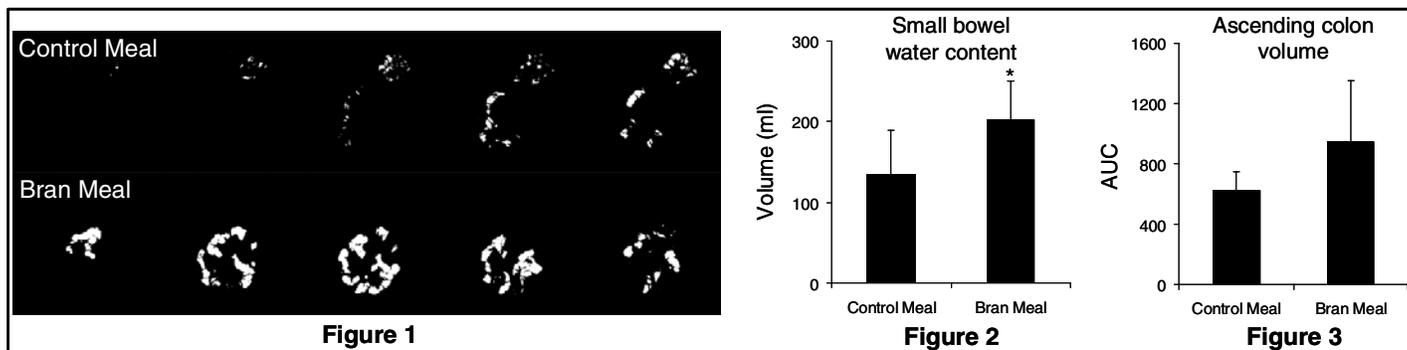
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**Background:** Irritable Bowel Syndrome (IBS) accounts for up to 40% of gastroenterology outpatients. Bloating, abdominal distension and pain are frequent but poorly understood complaints in these patients. Their symptoms can often be aggravated by bran [1], but the underlying mechanisms are currently unknown since it is poorly fermented and has only a small effect on bacterial mass. We have previously shown using gamma scintigraphy that both bran and plastic pellets were equally effective in accelerating small bowel transit [2], suggesting that bran acts via mechanical stimulation of the small bowel. Although we suspected that this was due to increased secretions, we could not assess this using gamma scintigraphy. Magnetic resonance imaging (MRI) allows for the first time high resolution, non-invasive, assessment of both motility and secretion induced by bran-containing meals.

**Aims:** This study built on our previous work and aimed to exploit the potential of MRI to test the hypothesis that bran acts by stimulating gastrointestinal secretion. We aimed to measure gastric emptying, small bowel water content and size of colon segments following a standard rice pudding test meal in healthy volunteers.

**Materials and Methods:** Twelve healthy volunteers, with no history of gastrointestinal disorder and of normal body frame, attended on 2 separate days, having fasted overnight. They were fed a standard 331 kcal rice pudding and jam meal together with 100 ml of orange juice with or without added 15 g of coarse wheat bran (2-ways). The subjects underwent serial imaging before ingesting the meal and then post-prandially at 45 min intervals for 8 hours. At time t=7 hours the subjects received a pasta and dessert meal (1007 kcal) with a drink of still water. All imaging was performed on a breath-hold on a 1.5T Philips Intera Achieva scanner. A transverse Balanced TFE sequence (TE=1.2 ms, TR=2.4 ms, Flip Angle 45°, 20 contiguous slices 10mm thick, FOV=400X70%, reconstructed matrix 256X256, scan time = 9 seconds) was used to measure volumes of the gastric lumen. A coronal Dual Echo FFE (TE=2.3 ms and 4.6 ms, TR=156 ms, Flip Angle 80°, 24 contiguous slices 10mm thick, FOV=450X80%, reconstructed matrix 157X256, scan time 13 seconds) was used to measure volumes of the ascending and descending colon. Finally, a coronal TSE (TE=320, TR= 8000, Fat sat SPIR, 24 contiguous slices 7mm thick, FOV=400X91%, reconstructed matrix 205X512, scan time 24 seconds) was used to measure volumes of water in the small bowel. The subjects' feelings of fullness, appetite, hunger, bloating, nausea and abdominal pain were monitored at every scanning time point using self-assessment satiety score questionnaires. This protocol was approved by the local Ethics Committee and volunteers gave informed written consent prior to experiments. Gastric and colonic volumes were measured manually on Analyze6. Analysis of the water content of the small bowel was carried out using software written in-house on IDL®. A threshold level was set on the images, below which all image data was ignored. Bright water signal from other organs such as the stomach, gall bladder, spinal fluid and bladder was easily identified and segmented out of the image, thus leaving only pixels containing water signal above the threshold in the small bowel. The volume of fluid in the small bowel at each time point was then calculated by integrating all such pixels. Data are expressed as mean±SEM. Two-tailed paired Student's t test was used.

**Results** (preliminary processing): The time to half empty the rice pudding meal from the stomach was 57 min (n=6) with no significant differences between bran and control meal. The bran meal increased small bowel secretion. **Fig. 1** shows 5 contiguous coronal TSE slices acquired across the abdomen of a volunteer at time t=225 min for both meals. The images were thresholded on the IDL® software to blank out all pixels with intensity below water. **Fig. 2** shows the average volume of small bowel water content measured with this procedure at time t=225 min for both meals (n=9, p<0.05). **Fig. 3** shows the Area Under the Curve (AUC) of the normalised volume of the ascending colon over the whole experiment day (n=3). The AUC under the sense of fullness of the volunteers was greater for the bran meal (2138±181) than for the control meal (1875±118) although not significant for n=9 (p<0.086).



**Discussion:** This study confirms the substantial effect of coarse bran on the small intestine. Bran, which produces only minor effects on meal viscosity and gastric emptying, appears to markedly increase small intestinal secretion. The most likely mechanism is via mechanical stimulation of serotonin release. The technique is non-invasive and allows serial studies. It is ideally suited to study mechanisms of secretion using serotonin agonists and antagonists. The observed increase in ascending colon volumes is likely to be due to increased fluid from the distal ileum entering the colon. These patient-friendly techniques will also allow us to investigate some of the clinical effects observed with bran supplementation in IBS patients and may allow us to better understand the basis of bran intolerance in IBS.

**References:** 1. Hebden, J.M., et al., Abnormalities of GI transit in bloated irritable bowel syndrome: Effect of bran on transit and symptoms. *American Journal of Gastroenterology*, 2002. 97(9): p. 2315-2320. 2. McIntyre, A., et al., Effect of bran, ispaghula, and inert plastic particles on gastric emptying and small bowel transit in humans: The role of physical factors. *Gut*, 1997. 40(2): p. 223-227.