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Pilot study comparing low-FODMAP spelt bread and gluten-free bread in IBS and IBD in remission: A randomised, single-blind crossover trial

A. Polgár[1*], K. Ács[2], T. Molnár[3], T. Resál[4], C. Lantos[2], E. Griechisch[5], K. Boda[5], J. Pauk[2**], F. Békés[6] and E. Mák[1]

[1] Department of Dietetics and Nutritional Sciences, Faculty of Health Sciences, Semmelweis University, Üllői út 26., 1085 Budapest, Hungary

[2] Cereal Research Non-Profit Ltd., Alsó Kikötő sor 9., 6726 Szeged, Hungary

[3] First Department of Internal Medicine, University of Szeged, Korányi Fasor 8-10, 6725 Szeged, Hungary

[4] North-Pest Central Hospital – Honvéd Hospital, Róbert Károly krt. 44., 1134 Budapest, Hungary

[5] Department of Medical Physics and Informatics, University of Szeged, Korányi Fasor 9., 6720 Szeged, Hungary

[6] FBFD PTY Ltd., Hull Road 34., Beecroft, NSW 2119, Australia

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ABSTRACT

Gastrointestinal diseases, including irritable bowel syndrome (IBS) and inflammatory bowel disease (IBD), which encompasses Crohn's disease (CD) and ulcerative colitis (UC), significantly impact the quality of life of affected individuals. While IBS is a functional disorder without structural changes in the digestive tract, IBD is manifested in chronic and immune-mediated intestinal alterations. Globally, IBS is 10 times more prevalent than IBD, with IBS accounting for 11% of the population and contributing to a substantial proportion of gastroenterology consultations. In Hungary, approximately 15–20% of the adult population

* Corresponding author. Tel.: +36302892430. E-mail: anialmap@yahoo.co.uk

** Corresponding author. Tel.: +3662435235. E-mail: janos.pauk@gabonakutato.hu

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experiences gastrointestinal symptoms. Dietary approaches, such as the low-FODMAP diet, have been validated to alleviate symptoms in IBS patients and offer potential benefits for IBD patients with IBS-like symptoms. This randomised, single-blind, crossover study evaluated the effects of a low-FODMAP long-fermented yeast spelt bread compared to a gluten-free bread on symptoms and quality of life in individuals with IBS and IBD. The study highlights the potential for low-FODMAP long-fermented yeast spelt bread to serve as a practical and palatable alternative to gluten-free bread, emphasising the importance of preparation methods and ingredient selection. While promising, further research with larger sample sizes is needed to establish the broader applicability of these findings.

KEYWORDS

low-FODMAP diet, low-FODMAP long-fermented yeast spelt bread, gluten-free bread, irritable bowel syndrome, inflammatory bowel disease

1. INTRODUCTION

Gastrointestinal diseases, such as irritable bowel syndrome (IBS) and inflammatory bowel disease (IBD), including Crohn's disease and ulcerative colitis, are common and significantly impact the quality of life (Black and Ford, 2020; Halmos, 2024). IBS affects approximately 1 in 10 people globally, ten times more than IBD, and this health challenge is a major cost driver when it comes to hospitalisation and visits to the emergency department (Black and Ford, 2020). IBS is a functional disorder with symptoms like bloating, pain, and altered bowel habits (Polgár et al., 2022), while IBD is chronic and immune-mediated, with similar symptoms and intestinal structural changes (Mentella et al., 2020).

Globally, IBD affects ~10 million people, 3.4 million in Europe and ~45,000 in Hungary (Polgár et al., 2022; EFCCA, 2024).

Up to 64% of IBS patients report food-related symptom triggers, including wheat, dairy, beans, cabbage, and fatty foods (Simrén et al., 2001; Polgár et al., 2022). Various dietary approaches – such as low-FODMAP, gluten-free, and Mediterranean – have shown benefits (Haghbin et al., 2024; Halmos, 2024), although no universally accepted guidelines exist (Polgár et al., 2022).

The low-FODMAP diet was developed by researchers at Monash University in Australia to help manage symptoms of IBS. It limits short-chain carbohydrates – fermentable oligo-, di-, monosaccharides and polyols (FODMAP) – that are poorly absorbed in the gut and can trigger bloating, gas, and abdominal discomfort (Halmos et al., 2014). The low-FODMAP diet, first validated in controlled trials (Halmos et al., 2014), is supported by extensive research for symptom relief in IBS (van Lanen et al., 2021; Black et al., 2022), and it may also help IBD patients in remission with IBS-like symptoms (Więcek et al., 2022). The diet has been evidence-based and recommended in Hungary for IBS since 2020 (EMMI, 2020), though no local clinical trials have yet been conducted.

Traditional gluten-containing grains, such as wheat, barley, and rye, are high in FODMAPs – particularly fructans – making them unsuitable for the low-FODMAP diet (Halmos et al., 2014). In contrast, gluten-free grains are naturally low in FODMAPs and are commonly recommended (Dieterich and Zopf, 2019). However, gluten-free products often lack fibre, have less protein

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content and other key nutrients, and may contain added sugars and fats, which can increase the risks of obesity due to the high glycaemic index (Vici et al., 2016).

The importance of diet in symptom management is well supported in IBS, yet the uptake of evidence-based approaches remains low. A targeted PubMed search identified only 30 low-FODMAP-related studies published in Europe over the last ten years – only three originating from Hungary (Halmos et al., 2014). This highlights a significant research gap and reinforces the necessity for localised studies focusing on diet-based management strategies for IBS and IBD.

A promising alternative is a low-FODMAP bread made from spelt, but the FODMAP content depends not only on the grain but also on the preparation method. Yeast fermentation – especially long fermentation – has been shown to degrade 40–78% of fructans *via* the enzyme invertase from *Saccharomyces cerevisiae*, while non-yeast fermentation is far less effective (Nilsson et al., 1987; Ziegler et al., 2016).

In Hungary, the Cereal Research Non-Profit Ltd. launched a breeding program in 2016 to develop low-FODMAP spelt genotypes with favourable baking qualities (Bekes et al., 2017). This study evaluates one such spelt variety to determine whether long-fermented spelt bread could serve as a viable alternative to gluten-free bread for individuals with IBS and IBD. Therefore, this pilot study aimed to compare the gastrointestinal symptom response and acceptability of long-fermented spelt bread with that of gluten-free bread in individuals with IBS or IBD in remission.

2. MATERIALS AND METHODS

2.1. Participants

Patients were recruited at the University of Szeged, Department of Medicine. Adults (>18) with confirmed IBS (Rome IV) or IBD were included. Exclusion criteria: coeliac disease, lactose intolerance, thyroid disorders, pregnancy, breastfeeding, or contraindications to oral feeding or blood sampling. Participation required informed consent; data were anonymised.

Of the 25 participants enrolled, 14 (6 IBS, 8 IBD) completed the study. Nine withdrew within the first 4 weeks for personal reasons, and two dropped out during the second bread phase due to digestive discomfort (e.g., diarrhea, cramps, flatulence). Most participants were female (64%), with a mean age of 58.8 ± 15.9 years (IBS) and 40.8 ± 13.9 years (IBD). Mean BMI was 26.3 ± 6.7 (IBS) and 26.8 ± 3.8 (IBD) kg m^{-2} (Table 1).

Table 1. Characteristics of study participants

	IBS	IBD
n (%)	6 (43%)	8 (57%)
Gender: male/female	1/5	3/5
Age (mean ± SD)	58.84 ± 15.90	40.75 ± 13.87
BMI	26.29 ± 6.72	26.83 ± 3.82

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2.2. Study design and data collection

This randomised, single-blind, crossover study included 25 participants, 14 of whom completed both phases of the study. Using computer-based randomisation, participants received either a low-FODMAP, long-fermented spelt bread (A), or a gluten-free bread (B) for 4 weeks, followed by a 4-week washout period and crossover to the alternate bread.

A gastroenterologist confirmed eligibility. At baseline, dietetic consultation included anthropometric data, lifestyle and health background, 3-day food diaries, and a validated Food Frequency Questionnaire. Participants received guidance and a Hungarian-translated low-FODMAP food guide (Monash-based).

During intervention periods, participants recorded daily gastrointestinal (GI) symptoms (abdominal pain, bloating, flatulence) using a 0–4 Likert scale, stool frequency, and mood (VAS 0–100 scale). IBS-specific Quality of Life (IBS-QOL) questionnaires were also completed and weekly averages were calculated.

2.3. Types of bread

Participants consumed ~200 g of bread daily, provided frozen, with refills available on request. Breads "A" and "B" were standardised in shape and weight. Nutritional and FODMAP compositions are detailed in Tables 2 and 3. Bread A (long-fermented spelt) contained low-FODMAP white spelt flour, water, baking yeast, and salt. Bread B (gluten-free) included starches (tapioca, corn, potato), rice and sorghum flour, dextrose, HPMC, guar gum, sugar, salt, soy protein, yeast, and water. White spelt flour was produced by EPMS mill (Kunszentmiklós, Hungary) from an improved spelt line of the Cereal Research Ltd. (Szeged, Hungary), all the other ingredients were purchased from local markets. Bread A was produced by Szegedi Sütödék (Szeged, Hungary), where first sourdough was made from white spelt flour, yeast, and water with 10 h of fermentation time, then traditional bread was produced using this sourdough. Bread B was produced by Cereal Research Ltd. according to the following steps: 1. mixing and kneading all ingredients, 2. distributing dough into baking pan and rising for 20 min at room temperature, 3. baking. Both breads were sliced and packed into 20 dkg units on the next day after baking, and kept frozen at −20 °C.

Table 2. The nutritional value in 100 g of Bread A and Bread B

	Energy (kJ/kcal)	Fat (g)	Carbohydrate (g)	Protein (g)	Fibre (g)
Bread A	1071/253	1.5	49	9.5	2.6
Bread B	1013/240	4.1	47	2.2	2.9

Table 3. The average carbohydrate composition of the breads that were tested in the study

	Fructose* (mg kg^{-1})	Glucose (mg kg^{-1})	Sucrose (mg kg^{-1})	Maltose (mg kg^{-1})	Raffinose* (mg kg^{-1})	Stachyose* (mg kg^{-1})	Fructan* (mg kg^{-1})
Bread A	0.00	0.4	2.90	23.7	6.9	0.2	500
Bread B	67.3	41.2	0.00	0.10	0.50	0.01	400

*excess of fructose (greater amount of glucose), raffinose, stachyose and fructan belongs to FODMAP carbohydrate.

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The low-FODMAP content was verified by measuring fructans using the AOAC 999.03 enzymatic/spectrophotometric method with Megazyme's Fructan HK Assay Kit (McCleary et al., 2000).

2.4. Statistical analysis

Descriptive data are presented as mean ± SD. For each 4-week period, a mean of 28 daily symptom scores was calculated and analysed using repeated measures ANOVA for a crossover design, assessing treatment, time, and carry-over effects using IBM SPSS software. Weekly averages were further compared by two-way repeated measures ANOVA, with LSD-adjusted pairwise comparisons on estimated marginal means.

3. RESULTS AND DISCUSSION

Patients reported mild symptoms throughout (mean scores 0.75–1.10). No significant time or carry-over effects were found. While abdominal discomfort and gas did not differ between breads, bloating was reduced with bread A ($P = 0.049$; Table 4).

With bread B, symptoms remained stable over time (Fig. 1A–C). In contrast, bread A exhibited a decreasing trend in all symptoms, with significant reductions in abdominal pain ($P = 0.005$) and bloating ($P = 0.001$) from week 1 to week 4.

Bowel movements showed no notable changes, though a slight decline was seen with bread A (Fig. 1D). Mood scores (VAS) ranged from 66 to 75; they remained stable with bread B but increased significantly with bread A ($P = 0.024$; interaction $P = 0.05$; Fig. 1E). According to VAS scores, 35% of patients showed improvement (≥10%) with bread A, 50% experienced minimal change (<10%), and 14% experienced worsening (≥10%).

While evidence for IBD-specific diets is limited, certain approaches – such as the Mediterranean or anti-inflammatory diet – may reduce gut dysbiosis and immune dysfunction associated with the Western diet (Covello et al., 2024; Deas et al., 2024). Many IBD and IBS patients

Table 4. The results of cross-over ANOVA for the overall average of the symptoms

	Bread A mean ± SD	Bread B mean ± SD	Estimated diff. mean (95% CI)	*P*-value (treatment)
Quality of life	2.45 ± 0.76	2.31 ± 0.81	0.134 (−0.239; 0.508)	0.449
Abdominal complaint	0.75 ± 0.58	0.77 ± 0.57	−0.035 (−0.308; 0.239)	0.787
Quantity of bloating	0.92 ± 0.65	1.10 ± 0.89	−0.363 (−0.725; −0.002)	0.049
Passing of gases	0.96 ± 0.34	1.08 ± 0.57	−0.098 (−0.359; 0.163)	0.429
Characteristics of stool	3.60 ± 1.99	3.55 ± 2.08	−0.515 (−1.619; 0.590)	0.330
Daily bowel movement	1.15 ± 0.42	1.14 ± 0.50	−0.025 (−0.136; 0.086)	0.634
VAS	70.65 ± 13.95	72.92 ± 13.53	−0.240 (−6.645; 6.166)	0.936

VAS: mood scores.

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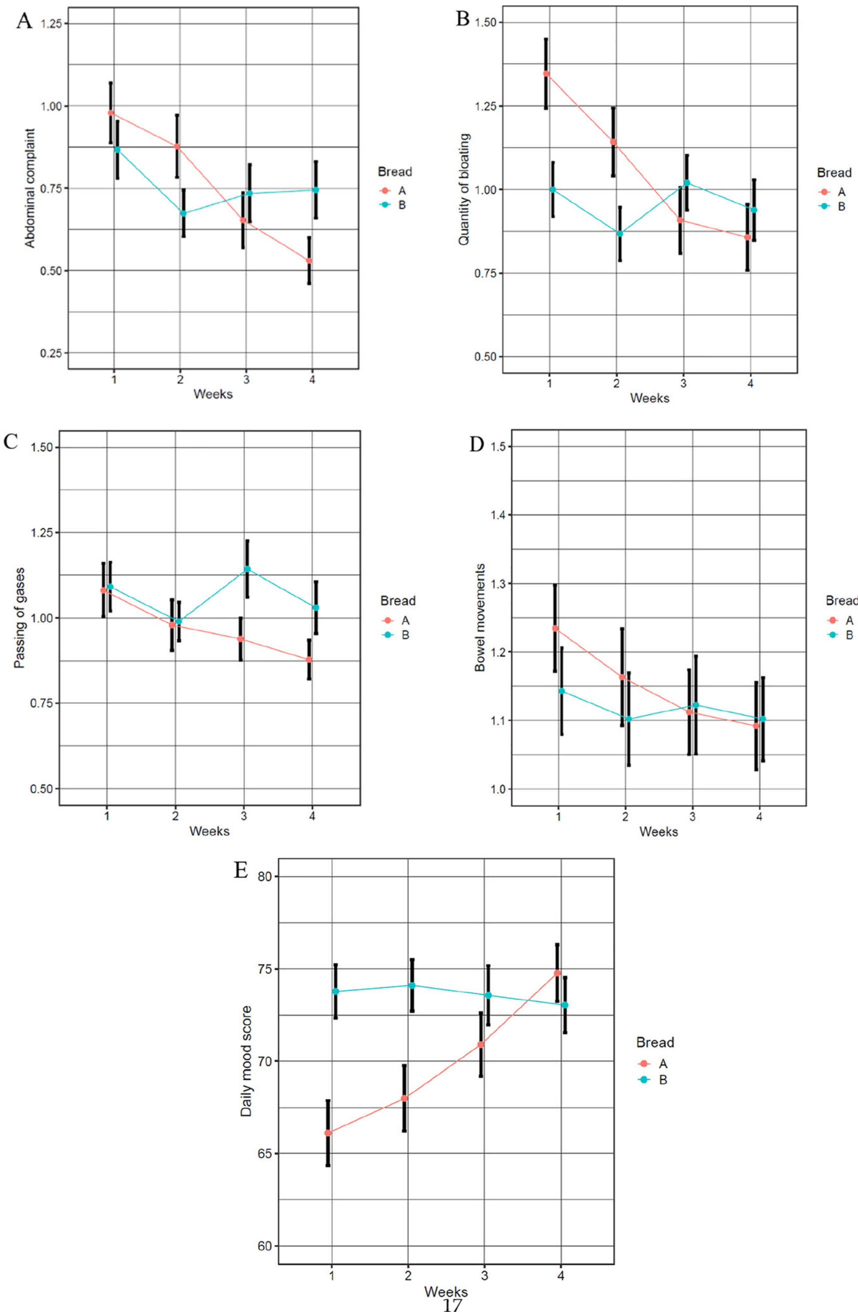

Fig. 1. Mean scores are shown for (A) abdominal pain, (B) bloating, (C) gas, (D) bowel movements, and (E) mood. Symptoms (A–C) were rated on a 0–4 scale (0 = none, 4 = intolerable), (D) reflects stools/day, and (E) mood was assessed *via* a 0–100 VAS (0 = worst, 100 = best)

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avoid gluten and dairy based on symptom triggers (Turnbull et al., 2015). IBS-like symptoms often occur in inactive IBD, and some studies suggest the low-FODMAP diet can improve these symptoms similarly to gluten-free diets in IBS (Gibson, 2017; Deas et al., 2024). However, FODMAP intake isn't consistently linked to inflammation, and restrictive diets may worsen malnutrition in IBD. Thus, while the low-FODMAP diet may help manage IBS-like symptoms in IBD, it should be followed under the supervision of a dietitian to ensure nutritional adequacy (Gibson, 2017).

According to the Food Frequency Questionnaire (FFQ), participants often consumed low-fibre diets but still included high-FODMAP products made from white flour. Dairy intake mainly involved fermented items, while soy and legumes were rarely consumed. Raw and fermented vegetables were common, but canned or frozen vegetables were less used. Most were unaware of the low-FODMAP diet; only two had seen a dietitian before.

Despite limited dietary control during the study, adherence to the low-FODMAP diet was ensured during the intervention phases. Participants consumed either gluten-free cereals or the provided spelt bread, which many preferred due to its taste and texture. Some reported symptom improvement with the spelt bread, highlighting the importance of ingredient choice and preparation method over strict gluten avoidance.

Fermented foods, such as sourdough, may be beneficial, but in Hungary, inconsistent definitions and production methods can mislead consumers about their FODMAP content. Overall, long-fermented low-FODMAP spelt bread may be a suitable option in FODMAP diets, though individual tolerance varies. Broader access to well-defined, gluten-containing FODMAP-friendly products remains a challenge. Further studies are needed.

4. CONCLUSIONS

This study highlights the increasing rates of IBS and IBD in Hungary, as well as the importance of dietary management. The low-FODMAP diet showed promise in reducing IBS-like symptoms, even in IBD remission. Long-fermented spelt bread may be a well-tolerated, palatable alternative to gluten-free products. However, individual variability and limited low-FODMAP gluten-containing options remain challenges. Broader education and further large-scale studies are needed to support the effective use of low-FODMAP diets in clinical care.

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