



Effects of a kefir supplement on symptoms, colonic transit, and bowel satisfaction score in patients with chronic constipation: A pilot study

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ABSTRACT

Background/Aims: Although probiotics have been extensively studied in irritable bowel syndrome, data on the impact of probiotics on chronic constipation are scarce. We aimed to evaluate the effects of kefir, which is a probiotic fermented milk product, on the symptoms, colonic transit, and bowel satisfaction scores of patients with chronic constipation.

Materials and Methods: Twenty consecutive patients with functional constipation according to the Rome II criteria were divided into two groups based on their colon transit studies: 1. The normal transit (NT) group (n=10); and 2. The slow transit (ST) group (n=10). After a baseline period, 500 mL/day of a probiotic kefir beverage was administered to all patients for 4 weeks. Defecation parameters (stool frequency, stool consistency, degree of straining, laxative consumption) were recorded in diaries daily by the patients. Bowel satisfaction scores were assessed using a visual analog scale. The colon transit study was repeated in the ST group at the end of the study.

Results: At the end of the study, the patients showed an increased stool frequency ($p<0.001$), improved stool consistency ($p=0.014$), and decreased laxative consumption ($p=0.031$). The degree of straining during evacuation showed a tendency to improve after kefir administration; however, this was not statistically significant ($p=0.18$). A repeat transit study showed an acceleration of colonic transit in the ST group ($p=0.013$). Bowel satisfaction scores also improved ($p<0.001$).

Conclusion: This pilot study shows that kefir has positive effects on the symptoms of constipation. Our results also suggest that kefir improves bowel satisfaction scores and accelerates colonic transit. Controlled trials are warranted to confirm these findings.

Keywords: Kefir, probiotic, constipation, therapy, gastrointestinal transit

INTRODUCTION

Chronic constipation is a common clinical condition that affects between 2% and 28% of the general population, depending on the diagnostic criteria used (1,2). Approximately 63 million people in North America meet the Rome II criteria for chronic constipation (3). In a country-wide study of 3214 people, the reported prevalence was 8.3% according to the Rome II criteria in the Turkish population (4). Constipation is associated with marked decreases in the quality of life (5).

Except for cases of constipation secondary to co-existing systemic illness or a colonic cause, most cases of

chronic constipation in adults are idiopathic and functional. Constipation can be divided into three broad categories: normal-transit constipation, slow-transit constipation, and disorders of defecatory or rectal evacuation (obstructive defecation) (6). Although constipation is a common problem for which a wide range of medicines are used, no agent for the treatment of constipation is effective for all patients, and the available therapies have limited efficacy (7). Alternative effective and safe treatment options are therefore still needed.

Probiotics are nonpathogenic microorganisms that when ingested in adequate amounts, exert health ben-

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efit on the host. There has been growing evidence (8-11) suggesting that probiotics may have a beneficial role in alleviating constipation symptoms in the adult and pediatric populations, at least with certain strains. Kefir is a fermented beverage originating from the Caucasian regions composed of a number of bacteria and yeasts living together in the polysaccharide grains secreted they secrete. The word kefir is derived from "kef", which means pleasant taste in Turkish. Kefir can be considered a probiotic source with anti-bacterial, anti-mycotic, anti-neoplastic, and immunomodulatory properties (12).

To date, there has been no study assessing the effect of kefir on constipation symptoms. The aim of this study was to evaluate the effects of kefir supplements on symptoms, colonic transit, and bowel satisfaction scores in patients with chronic constipation.

MATERIALS AND METHODS

Patient population and selection criteria

We enrolled patients from Constipation, Incontinence & Biofeedback Unit of Gastroenterology Department of Ege University. This unit is one of the few and certainly the largest center specializing in providing medical care to patients with constipation and fecal incontinence in Turkey. All patients completed a detailed questionnaire, including 40 questions assessing socio-demographic characteristics, the duration and severity of constipation symptoms, stool frequency, degree of straining, stool consistency [Bristol Stool Form Scale (BSS)], obstetric history for women, co-morbid illnesses, previous surgeries, and drugs used.

All subjects underwent a flexible sigmoidoscopy, colonoscopy or barium enema and blood tests (complete blood count, biochemistry, and thyroid function tests) to exclude the structural and metabolic disorders that could lead to constipation.

Patients were eligible if they met the diagnostic criteria for functional constipation according to the Rome II criteria. In brief, they reported two or more of the following symptoms for at least 12 weeks in the preceding 12 months and for at least one-fourth of the time: 2 or fewer bowel movements per week, lumpy or hard stools, straining at defecation, sensation of incomplete evacuation, sensation of anorectal blockage, or manual maneuvers to facilitate defecation.

Patients were excluded if they had an obstructive pattern of defecation as described below, symptoms of irritable bowel syndrome, self-reported lactose intolerance, previous gastrointestinal surgery except for appendectomy, neurological diseases, or any other significant co-morbid illnesses such as severe cardiac disease, chronic renal failure, uncontrolled or insulin-dependent diabetes mellitus, alcohol or drug dependence, or major psychiatric disorders. Patients taking drugs that are known to be constipating, such as calcium channel blockers,

and women who were pregnant or were likely to conceive during the course of study were also excluded. The criteria used to identify those patients with self-reported lactose intolerance were as follows: 1) subjects had reported one or more of the following symptoms after ingesting milk or other dairy products: abdominal bloating, gas, abdominal pain or discomfort, and diarrhea; and 2) subjects had eliminated milk and other dairy products from their diets.

All subjects underwent a comprehensive evaluation of their anorectal function that included anorectal manometry, a balloon expulsion test, and a colon transit study.

Anorectal functional tests

Anorectal manometry was performed using a low compliance water perfusion system (Medical Measurement Systems, the Netherlands), and all pressure measurements and rectal sensitivity studies were performed as described by Rao et al. (13). For the balloon expulsion test, a standard fusiform-shaped latex balloon (size 4x9 cm) was used (Medical Measurement Systems, the Netherlands). Details of the technique and normal values for our population can be found elsewhere (14). Colonic transit was assessed using radiopaque marker techniques (15). In brief, patients ingested a single capsule containing 24 radiopaque markers (Sitzmarks; Konsyl Pharmaceuticals, Fort Worth, TX, US) on day 1, and a supine X-ray of the abdomen was obtained on day 6 (120 hr later). The X-rays were analyzed to assess the number and distribution of the markers.

Obstructive defecation was diagnosed if the patients showed an inappropriate contraction of the anal sphincter pressure or less than a 20% relaxation of the basal resting sphincter pressure during attempted defecation, as assessed using anorectal manometry. Additionally, patients had to meet at least one of the following criteria: 1) evidence of impaired evacuation, based on the balloon expulsion test (more than 30 sec for men younger than 40 years of age and more than 1 min over 40 years; for women, more than 1 min) (14); and 2) >5 markers at 120 hr in the rectosigmoid region (without other regions) on X-ray. These patients were excluded from the study.

Kefir product

Kefir products were specifically prepared for the study and provided by the Altinkılıç Company (Altinkılıç Food and Milk Industry Incorporated Company, İstanbul, Turkey) in the form of a 250-mL bottle without a label to mask the subjects from the identity of the product. The nutritional and microbial contents of the kefir used are shown in Table 1.

Study design

The study was designed in a single-center, uncontrolled, patient-blinded manner. Patients were divided into two groups, based on their colon transit studies: 1) Normal transit (NT) group (<5 markers at 120 hr); and 2) Slow transit (ST) group (>5 markers at 120 hr throughout the colon). All subjects gave

written informed consent for the study and the protocol was approved by the Human Ethics Committee of Ege University.

Seven days prior to and during the treatment period, all patients recorded a daily log of their bowel symptoms, in which they wrote the stool frequencies, degree of straining (normal, moderately excessive, severe), stool consistency (hard, normal, loose), and laxative consumption. The pattern of stool consistency was categorized based on the BSS. Stools rated as 1 or 2 on the BSS were defined as hard; those rated 6 or 7 were defined as loose; and those rated 3, 4 or 5 were defined as normal.

After a 1-week baseline period, the subjects ingested 500 mL/day of kefir after their morning and evening meals for 4 weeks. Subjects were asked to maintain a consistent diet and activity level throughout the study but were not permitted to consume any other probiotic dairy beverage. All patients were followed up weekly at the outpatient clinic after the initiation of treatment. At each visit, the physician assessed the patient's daily bowel diary and examined the patient. Kefir products were given to the patients weekly during the visits. Adverse events were also monitored.

Each patient was asked to grade his or her satisfaction or dissatisfaction with bowel habits, both before and after kefir beverage consumption, using a visual analog scale (VAS) of 0-10, where 10 was very dissatisfied.

After the completion of kefir administration, a colon transit study was repeated in the ST group.

Statistical analysis

To compare the baseline demographic and clinical variables between the NT and ST groups, the Fisher's exact test and Mann-Whitney U-test were used for nominal and ordinal variables, respectively. In the total study group, the differences before and after kefir administration were analyzed using the Wilcoxon signed-rank test in ordinal variables and the McNemar test in nominal variables. A p value <0.05 was considered to be

Table 1. The nutritional and microbial content of the kefir used in the study

Microbial content	
• Lactococci (cfu/g) (<i>Lactococcus lactis</i> ssp. <i>lactis</i>)	10 ¹⁰
• Lactobacilli (cfu/g) (<i>Lactobacillus pentosus</i>)	4.7x10 ³
• Yeast (cfu/g) (<i>Saccharomyces</i> species)	7x10 ³
Nutritional composition	
• Carbohydrate (g/100 g)	4.49
• Fat (g/100 g)	3.10
• Protein (g/100 g)	3.13
• Energy (kcal/100 g)	58

statistically significant. All analyses were performed using SPSS software (version 20.0; SPSS Inc., Chicago, IL).

RESULTS

A total of 20 patients (10 with normal transit [NT group] and 10 with slow transit [ST group]) aged 27-78 (mean age±SD: 51±14.37, male/female: 7/13) were enrolled into the study. All patients completed the study, and no product was returned to the laboratory. Baseline characteristics of the subjects showed no significant differences between the NT and ST groups (Table 2).

At the beginning of the study, the median stool frequency was two times per week (range one to five) in the study group. After the 4-week product intervention, the stool frequency increased in 18 of 20 patients and did not change in 2 patients. The median stool frequency was five times per week (range two to seven) at the end of the kefir consumption period (p<0.001) (Figure 1).

The stool consistency was reported as hard in 12 patients at baseline. Fifty percent of these patients reported normal stools at the end of study (p=0.014) (Figure 2). Stool consistency did not change in patients who reported their consistency as normal or loose.

The degree of straining during defecation showed a tendency to improve after kefir administration (Figure 3); however, this was not statistically significant (p=0.18).

Sixty percent of patients (n=12) had been consuming at least one laxative drug at the beginning of the study. At the end of the 4-week kefir intervention, 50% of these patients (n=6) had stopped the laxatives (p=0.031).

There was a significant improvement in the bowel satisfaction scores after the completion of the kefir regimen (p=0.001) (Figure 4). Eighty percent of the patients (n=16) reported an improvement in their scores at the end of the study.

In the ST group (n=10), colonic transit was significantly shortened after the 4-week kefir administration (p=0.013) (Figure 5). In 8 of 10 patients, the colon transit study showed that the number of radiopaque markers at 120 hr on X-ray had decreased compared to the baseline. The number of radiopaque markers increased in one patient and did not change in another.

No significant adverse events were reported to be associated with kefir supplementation; one patient suffered from bloating, and one had nausea. Both cases were mild and self-limiting, and neither caused the patient to interrupt his or her treatment.

DISCUSSION

The results of this pilot study suggest that the use of kefir increases the frequency of defecation and leads to a signifi-

Table 2. Baseline characteristics of subjects: comparisons between groups

	Normal transit (NT) group	Slow transit (ST) group	p value
Age, median (range)	52 (27-74)	51 (31-78)	NS
Sex ratio (female/male)	6/4	7/3	NS
Stool frequency/week, median (range)	2 (1-3)	2 (1-5)	NS
Stool consistency [‡] , n (%)			NS
Hard	6 (60)	6 (60)	
Normal	3 (30)	4 (40)	
Loose	1 (10)	0	
Degree of straining, n (%)			NS
Severe	4 (40)	4 (40)	
Moderately excessive	5 (50)	4 (40)	
Normal	1 (10)	2 (20)	
Laxative consumption, n (%)			NS
Yes	6 (60)	6 (60)	
No	4 (40)	4 (40)	
VAS, median (range)	8 (5-10)	8 (6-9)	NS
Number of radiopaque markers [‡] , median (range)		11 (8-18)	

VAS: visual analog scale; NS: non-significant

[‡]According to the Bristol Stool Form Scale (BSS). Stools rated as 1 or 2 on BSS were defined as hard; those rated 6 or 7 were defined as loose; and those rated 3, 4 or 5 were defined as normal.

[‡]The number of radiopaque markers in colonic segments during the colon transit study.

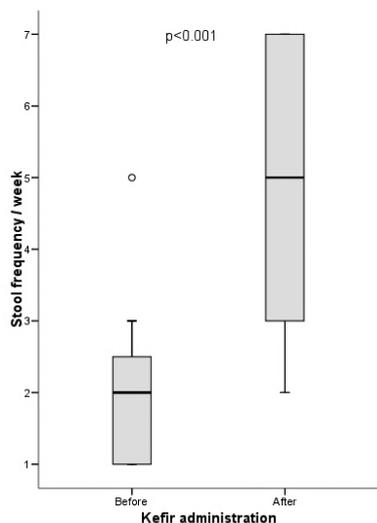


Figure 1. Box plot of stool frequency per week before and after kefir administration. The box includes observations from the 25th to the 75th percentile, and the horizontal line within the box represents the median value

cant improvement in stool consistency. Kefir supplementation was also associated a with statistically significant decrease in the use of laxatives, improvements in bowel satisfaction scores, and shortened colonic transit times. No significant changes in the degree of straining during defecation were found.

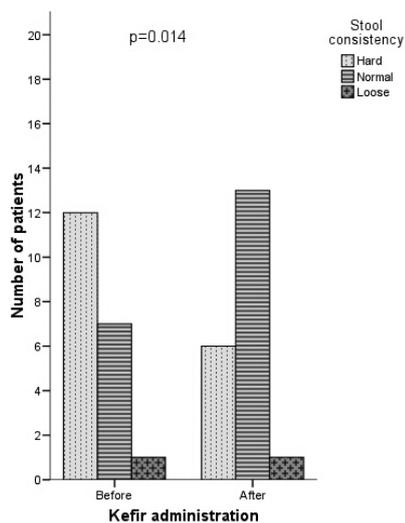


Figure 2. The changes in stool consistency before and after kefir administration

Kefir is a probiotic fermented milk product that originates in the Caucasus region. The fermentation of kefir is achieved by kefir grains, which are a cluster of microorganisms held together by a resilient polysaccharide matrix named kefiran, itself a water-soluble branched glucogalactan. Different species of bacteria and yeasts in kefir have been identified from several regions and sources and using both culture-dependent and molecular methods (12). Among them, the species most frequently

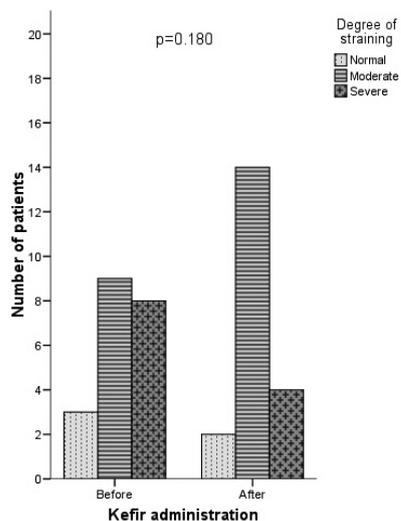


Figure 3. The changes in the degree of straining during defecation before and after kefir administration

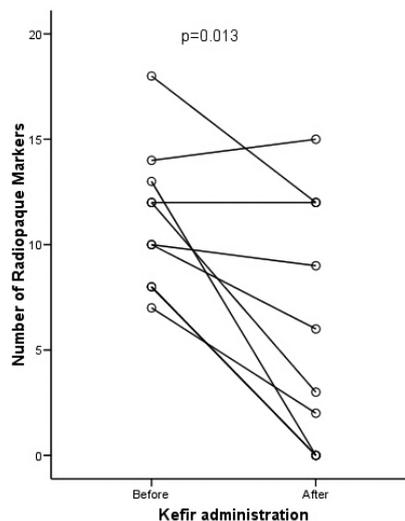


Figure 5. The changes in the number of radiopaque markers on colon transit study in the ST group after kefir administration

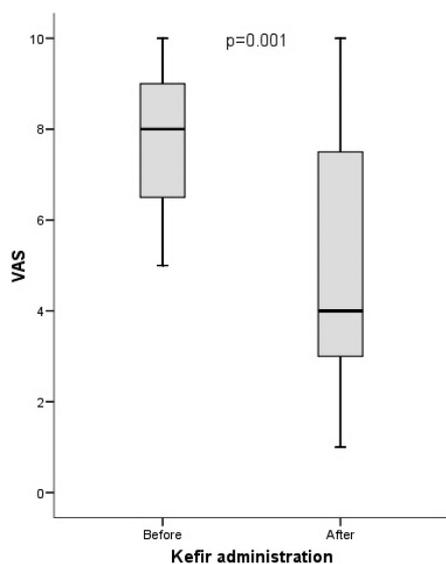


Figure 4. Box plot of bowel satisfaction scores before and after kefir administration. Bowel satisfaction scores were assessed using a visual analog scale (VAS) of 0-10, where 10 is very dissatisfied. For an additional explanation of the box plot symbols, please refer to the legend to Figure 1

reported are lactobacilli, lactococci, leuconostocs, acetic acid bacteria, and yeasts (both lactose-fermenting and nonlactose-fermenting) (16-18). The microbiological and chemical compositions of kefir contribute to its complex probiotic effect due to the presence of lactic acid bacteria and yeast (12). Several studies have demonstrated the anti-bacterial, anti-mycotic, anti-neoplastic and immunomodulatory properties of kefir (12).

Constipation is a common problem, with an estimated prevalence reaching up to 20% in some populations (19). Despite its high prevalence, the available therapies are unsatisfactory (7). In a population-based survey, Johanson et al. (20) reported

that nearly 50% of patients with chronic constipation were not satisfied with their treatment.

Growing evidence suggests that probiotics may contribute to ameliorating the symptoms of functional constipation (8-10). The rationale for the use of probiotics in the treatment of functional constipation is based on data demonstrating differences in the intestinal microbiota between constipated and healthy subjects, although very little is known regarding either quantitative or qualitative changes in the bacteria or other organisms under these condition (21). Khalif et al. (22) demonstrated that the populations of lactobacilli and bifidobacteria were reduced in adult constipated patients. An older study showed increased numbers of clostridia and bifidobacteria, whereas nonpathogenic *Escherichia coli*, bacteroides and the total number of microorganisms increased among children with constipation (23).

Three randomized controlled trials (RCT) thus far are available in the pertinent literature regarding the use of probiotics in adults for the treatment of chronic constipation (8-10). In the first study, Möllenbrink and Bruckschen (8) treated 70 constipated patients with *E. coli* Nissle 1917 or placebo. After four and eight weeks of treatment, the average number of stools per week was significantly higher in the probiotic group than in the placebo group. The next RCT (9) evaluated the effects of administering *Lactobacillus casei* Shirota for four weeks to 70 patients with chronic constipation. Patients in the probiotic group, compared with the placebo group, had significant improvements in the self-reported severity of constipation and in stool consistency. After the 4-week intervention phase, the limited defecation frequency of three times or less per week was found less in the treatment group, although this outcome was not statistically significant. In the final examination, a considerable proportion of the probiotic group (89%) reported a positive effect of their beverage on consti-

pation (56% in the control group). The study by Yang et al. (10) randomly assigned 135 adult women with constipation to consume either a fermented milk product containing *Bifidobacterium lactis* DN173010 and some yogurt strains or an acidified milk containing non-living bacteria (control) for two weeks. Patients in the experimental group, compared with the control group, had a significantly higher stool frequency and better improvement in the defecation conditions and the stool consistency scores at both one and two weeks after product consumption. A more recent double-blinded RCT by Del Piano et al. (24) evaluated the effectiveness of two different probiotic blends, either mixed *Lactobacillus plantarum* LP01 and *Bifidobacterium breve* BR03 or *Bifidobacterium animalis* subspecies *lactis* BS01, in 300 healthy volunteers with evacuation disorders and hard stools. Compared with the placebo group, subjects receiving either mixed probiotic strains *L. plantarum* LP01 and *B. breve* BR03 or *B. animalis* subsp. *lactis* BS01 reported a significant improvement in the number of weekly bowel movements and in the major problems associated with evacuations, particularly the consistency of feces and the ease of expulsion. The parameters regarding the intestinal discomfort, such as abdominal bloating and anal itching, burning, or pain also showed a relevant improvement in the active groups receiving probiotics.

The data published to date suggest that adults with constipation might benefit from the ingestion of *B. lactis* DN173010, *L. casei* Shirota, and *E. coli* Nissle 1917, which have been shown to increase defecation frequency and to improve stool consistency. Although the aforementioned studies have proven the efficacy of probiotics, a recent systematic review of RCTs concluded that there is still limited evidence available from controlled trials to evaluate with certainty the effect of probiotic administration on constipation (25). Our study provides additional evidence that kefir (as a probiotic) can improve constipation symptoms in adults; however, some other possible effects should also be taken into consideration.

There are no other studies that have investigated the effect of kefir on gastrointestinal disorders. In an animal study, Maeda et al. (26) showed that the administration of kefir to constipated Sprague-Dawley rats induced by a low-fiber diet caused an objective improvement in the levels of fecal moisture and wet weights of feces compared with the control group. The authors concluded that the administration of kefir was effective in improving defecation. Kefir also seems to improve lactose digestion and tolerance in adults with lactose maldigestion (27).

In our study, we also investigated the effect of kefir on bowel satisfaction scores and colonic transit. Eighty percent of the study patients reported an improvement in their bowel satisfaction scores, as assessed using VAS at the end of the kefir administration. The colonic transit assessment also showed that kefir is associated with the acceleration of colonic transit in patients with slow transit (ST group). Several studies have shown

that probiotics can improve colonic transit times in a healthy population (28) and in constipated patients (29,30). Cardoso et al. (31) reported that kefir could enhance intestinal transit in Wistar rats. Our study is the first to show that kefir may have favorable effects on colonic transit in constipated patients with slow transit. Although the exact mechanisms of how probiotics accelerate intestinal transit are still unclear, it has been proposed that probiotics lower the pH in the colon by producing lactic acid, acetic acid, and other acids. These effects result in enhanced peristalsis and, subsequently, in decreased colonic transit time (28,32).

The major limitation of this pilot trial is the fact that the results were obtained from a single center, the limited number of patients, and the lack of a control group. The choice of an uncontrolled design was based on the consideration that it was not possible to prepare a control product with a similar flavor, appearance, texture, and taste as those of kefir. Despite the lack of a control group and the limited number of patients, the results seem to be encouraging. These preliminary findings underline the need for larger controlled (if possible) studies designed to explore the benefits of kefir for use in patients with chronic constipation.

In conclusion, probiotics have growing popularity in the management of chronic constipation over the past decades. In the era of more novel therapies, kefir may play a role in alleviating constipation symptoms. Our preliminary results also suggest that kefir improves bowel satisfaction scores and accelerates colonic transit.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Ege University Faculty of Medicine.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author contributions: Concept - I.T., O.D., S.B., T.I.; Design - I.T., O.D., S.B., T.I.; Supervision - S.B., T.I.; Resource - I.T., O.D.; Materials - I.T., O.D.; Data Collection&/or Processing I.T., O.D., S.B.; Analysis&/or Interpretation - I.T., O.D., S.B.; Literature Search - I.T., O.D., S.B.; Writing - I.T., O.D., S.B.; Critical Reviews - I.T., O.D., S.B., T.I.

Conflict of Interest: No conflict of interest was declared by the authors.

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