

# Association of Gut Flora and Short-Chain Fatty Acid Metabolite in Functional Constipation and Regulation of High-Fibre Diet on Them

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**Abstract.** Constipation is one of the most prevalent diseases in the world, and it has a significant impact on the quality of life of people. There are several critical factors associated with constipation, including short-chain fatty acid content and the composition of the gut microbiota. A disorder in any of these factors can cause an abnormal bowel movement and the symptoms of constipation. Diet regulates the gut microbiota and influences the immune system. Recent research suggests that high fibre foods promote the growth and stabilization of the intestinal nerves, as well as an increase in the number of useful bacteria found in the intestines. Fibre deficiency increases the risk of GI distress and contributes to poor gastrointestinal motility. Long-term treatment of constipation is dependent on developing a diet that provides sufficient fibre. A high fibre diet is probably not just essential to manage constipation, but also to lower the risk of developing other chronic illnesses associated with diet. In this paper, the relationship between high fibre diet and microbiota and short chain fatty acids in constipation patients is analyzed.

**Keywords:** Constipation; high-fibre diet; SCFA; intestinal flora.

## 1. Introduction

Constipation is a widespread gastrointestinal disorder affecting a significant portion of the population worldwide. The global pooled prevalence of functional constipation may be as high as 15.3% [1]. Although constipation is not considered a life-threatening condition, it can significantly impact an individual's quality of life and may result in more serious health issues if left untreated. As constipation is subjective, its definition should take into account not only the frequency of bowel movements but also the patient's perception of discomfort during defecation [2].

Recent research suggests that changes in intestinal flora could be a cause for constipation. The term 'intestinal microbiota' means the whole range of organisms that reside in the digestive tract of a person, such as bacteria, archaea, and eukaryotes. Bacteria in the intestine can be as many as 10 times larger, according to various studies with different outcomes [3].

Because there are no enzymes in the human body that can break down dietary fibre, the gut microbiota crucially partakes in the digestion of this kind of nutrition. Short Chain Fatty Acids (SCFAs) are one of the main fermented products that arise from the interaction of food fibre with intestinal microbiota (Fig. 1). On the other hand, SCFAs resulting from the consumption of dietary fibre are the main sources of such substances in man.

The purpose of this paper is to explore the interplay of intestinal microbiota, SCFAs, and constipation, as well as their possible clinical significance and implications for further studies. The synthesis of SCFAs and changes to structure of the gut microbiota were two potential reasons for the development of constipation that were discussed [4]. In addition, the impact of dietary fibre on intestinal microbiota and SCFAs was investigated.

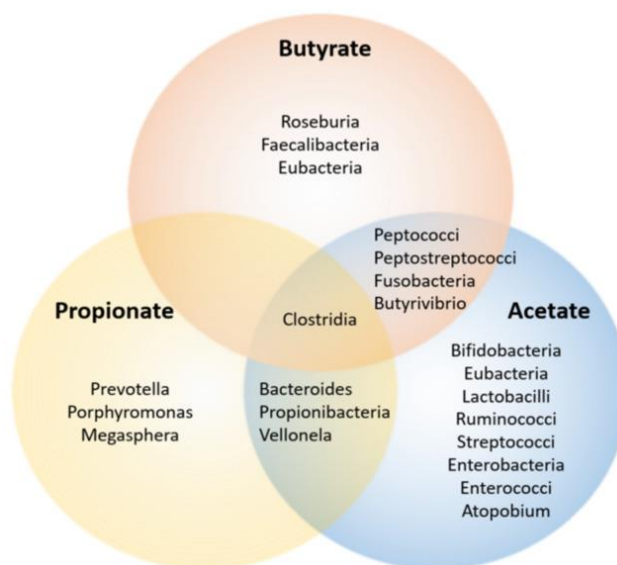


Fig 1. SCFA-producing microbiota [5]

## 2. The Cause of Constipation

Constipation occurs when people have less than three bowel motions per week, and stools are firm, dry, and lumpy; constipation or diarrhea that is painful to pass or the perception that not all feces have been expelled. Several different things bring on constipation, including not low fibre diet, lack of exercise, drinking enough water, using some drugs, or having a medical condition.

Constipation is a common symptom of eating a diet low in fibre. Fibre is the indigestible component of plants. It survives the digestive process relatively unharmed, increasing the stool's density and facilitating its passage through the colon. Consuming a low-fibre diet can cause the seat to become stiff and dry, which might obstruct the digestive tract [6]. This may cause bowel obstruction. Diets poor in fibre tend to be high in processed foods and low in whole foods, including vegetables, fruits, and legumes.

Lack of vigorous exercise is a common cause of constipation. Physical activity stimulates the digestive tract muscles, which in turn aids in the passage of feces through the colon. Inactivity can cause the digestive tract muscles to atrophy and slow down bowel movement, leading to constipation. Being overweight or obese and eating a diet low in fibre are both variables that can be exacerbated by a lack of physical activity, increasing the likelihood that people will get constipation [7]. Constipation can occur from insufficient movement, so keeping active is crucial. Moderate physical activity, walking, yoga, or stretching, can help keep the bowels working properly. Strive for thirty minutes of moderate physical activity each day of the week. Keeping well-hydrated with water and other fluids is also crucial during physical activity.

Drinking enough water during the day is essential to avoid constipation, which can be a side effect of dehydration. In a state of dehydration, the body pulls as much water as it can from the feces, making passage increasingly difficult [8]. Consume a lot of fluids, especially water, throughout the day to avoid constipation caused by dehydration.

Many medications have constipation as a frequent side effect, including painkillers, antidepressants, and blood pressure drugs. A person taking medicine for constipation should consult their doctor about other treatment options. Irritable bowel syndrome (IBS), hypothyroidism, and neurological diseases are just a few of the medical issues that can lead to constipation. Specific health issues may disrupt regular bowel movements. See a doctor for an accurate diagnosis and effective treatment of constipation if it lasts more than a few days or is accompanied by other symptoms.

Constipation may be more common in the elderly due to several factors. Furthermore, the aging body may experience a weakening of the muscles that control bowel movements, which can make defecation more of a challenging field [9]. But constipation is not a regular aspect of becoming older,

it may be avoided or controlled with some effort, such as increasing physical activity, eating a diet high in fibre and drinking enough water.

Constipation may be caused, in part, by hormonal changes that impact digestion and bowel motions, including pregnancy-related hormone changes that impede digestion and relax intestinal wall muscles. Large amounts of the hormone progesterone are produced during pregnancy, and this hormone can cause constipation by softening the colon's muscles and decreasing the frequency of bowel movements. Alterations in bowel regularity are another symptom of hormonal shifts, such as during the menstrual cycle when estrogen and progesterone levels rise and fall, respectively [10]. When a woman's period approaches, she may have either constipation or diarrhea. Increased fibre and water intake, frequent exercise, and laxatives, as advised by a healthcare expert, can help with constipation caused by hormonal fluctuations, as can correcting the underlying hormonal imbalance with medicine or lifestyle modifications.

Constipation can result from shifts in the gut bacteria, as these changes can affect how the digestive system works., namely a lack of diversity or an overgrowth of specific types of bacteria. Evidence suggests that persons who suffer from constipation have an imbalance in their gut microbiome, with fewer good bacteria like *Bifidobacterium* and *Lactobacillus* and more significant numbers of potentially hazardous bacteria like *Clostridium difficile*. Some consequences of this disproportion include diminished digestive efficiency and fewer bowel motions [11]. In addition, gut flora might affect neurotransmitters like serotonin, which help control bowel motions. Alterations in serotonin synthesis due to changes in the gut microbiota may cause irregular bowel movements or even contribute to constipation. Interventions like probiotics and prebiotics, which can aid in re-establishing a healthy gut-bacterial balance, may help treat constipation brought on by changes to the gut microbiota.

### **3. High-fibre Diet in Constipation Treatment and Gut Microbiome Modulation**

#### **3.1. High-fibre Diet in Treatment of Constipation**

Nutrition research has proved that dietary fibre can directly enter the large intestine, stimulate and promote intestinal peristalsis, make stool easy to discharge, reduce the pressure in the large intestine, effectively prevent constipation and other colorectal diseases [12]. Dietary fibre, also called food-fibre, is a kind of carbohydrate which cannot be decomposed by digestion enzymes, such as cellulose, hemicellulose, gum, pectin, lignin, etc. The high cellulose content of food is mainly found in fresh vegetables, such as celery, leek, spinach, dried bamboo shoots, and cereals, such as cereals and rice. Patients with constipation should be encouraged to eat food rich in fibre, such as fresh vegetables, fruits and other high-fibre food, reduce the consumption of high-fat, high-sugar foods and excessive dairy products, to keep the intestinal tract clean, in order to reduce the occurrence of constipation and prevent cancer, to maintain the physical and mental health of patients with constipation. Marianela and her colleagues discovered that high-fibre diets not only increased the efficacy of the ANORECT, but also improved the quality of the abdomen. After treatment with high fibre diet (25~30g/day), patient whose defecation obstacles had been overcome (>20% reduction in anal pressure during the defecation maneuver) [13].

#### **3.2. High-fibre Diet Modulates Gut Microbiome**

A diet rich in fibre will change the microbiota and trigger a personalized immune response. Although microbial diversity is stable, the fibre rich diet increases the active carbohydrate enzymes (CA Zymes) encoded by the microbiome for the degradation of glycans (Fig. 2, Fig. 3) [14]. The mechanism of microbiota-available carbohydrate (MAC) has been demonstrated in the study on the basis of the function of short-chain fatty acids (SCFA) in promoting intestinal microbiota diversity and metabolism.

Using a variety of histological measures of microbiome and host parameters, including cutting-edge sequencing technology and immune testing, Wastyk and his colleagues have found that eating

high-fibre, high-fermentation foods affect the human microbiome and biology in a variety of ways [14]. Shyamchand and coworkers conducted a dietary fibre intervention trial in 53 obese patients and found that patients in the dietary fibre intervention group had significantly lower body weight and significantly increased abundance of *Lachnospira* in the gut [15]. While Wang and his team fed rats with high fat content, they reduced their body mass and increased intestinal bacterial abundance [16]. High fibre, plant foods seem to be good for health, as they facilitate intestinal microbial growth and even spread across species. In one research, the bacteria in India were compared with those in China. The Chinese diet had a greater share of animal fat and protein, whereas India's diet consisted mostly of grain and vegetable vegetables. In India, the percentage of bacteria in the micro-biomes was nearly fourfold (16.39%) compared to China (4.27%). Moreover, India had a much greater percentage of pre-menopausal women (13.07%) compared to China (0.58%) [17].

While recent studies suggest that such foods may have significant impacts on microbial health and immunity, there is still much to be done to investigate how they relate to each other in the biological context, with special attention being paid to the role of other experimental models.

Fecal microbiome transplantation and transgenic techniques restore the condition of the pathological change in humans. As for which kind of microbiome or gene cause the functional constipation, the mass screening among normal people and patients will be conducted so as to find out the disparities. And this screened factor is estimated to provide a more convincing disease model. Environmental, cultural, ethnic, dietary, or gene are etiological factors that can influence reporting of symptoms. With the improving disease model, the mechanism of functional constipation will be clearly elucidated.

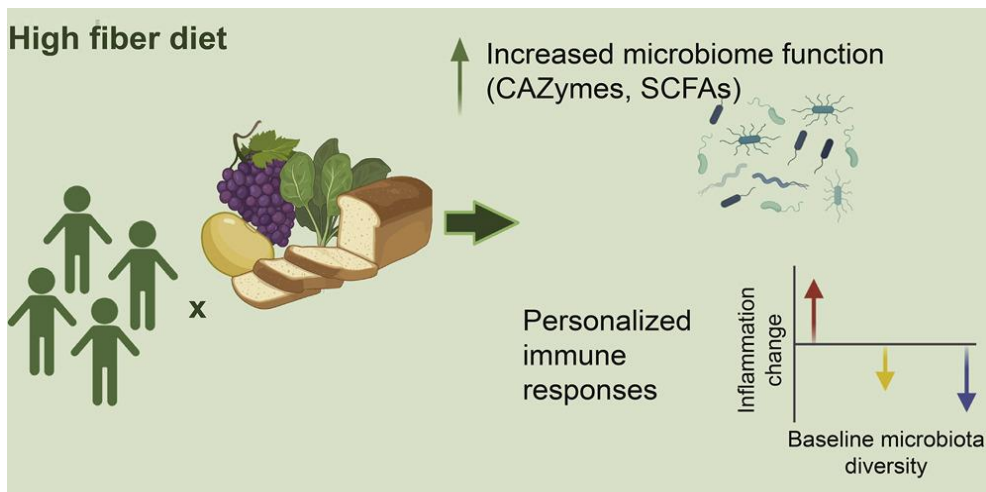


Fig 2. High-fibre diet alters microbiome and triggers immune response [14]

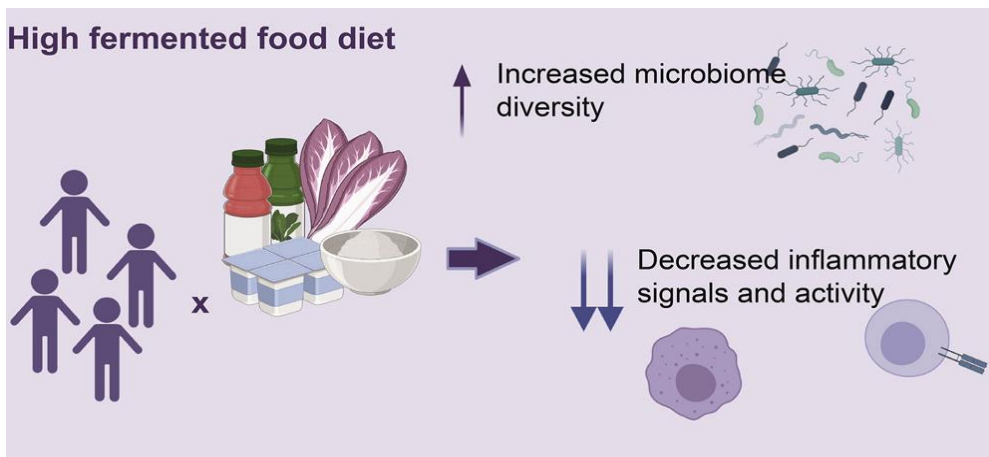


Fig 3. Fermentation diet alters microbiome and reduces inflammation [14]

#### 4. SCFAs and Constipation and Gut Microbiota

SCFAs synthesis changes have been found associated to changes in the gut microbiota, which can affect constipation and stool consistency. Studies in animals have demonstrated that Maren Pills can alter gut microbiota composition and change the production of SCFAs, leading to improvements in constipation [18]. Similar associations have been observed in human randomized controlled trials. For example, Miyoshi et al. found that prebiotics can improve stool form in dialysis patients by changing gut microbiota composition and SCFA levels [19]. However, such associations are sometimes limited to a single type of SCFAs. Buprenorphine, for example, has been shown to enhance intestinal transmission ability in slow-transit constipation rats by regulating intestinal microbiota [20]. In addition, Chu et al. found that UG1601 probiotics relieved intestinal symptoms in constipated adults by increasing the profusion of butyrate-producing bacteria and altering gut microbiota composition [21].

SCFAs also serve to maintain the integrity of the intestinal barrier, which protects the gut microbiota in cases of constipation. This is probably due to the fact that SCFAs are engaged in signaling between the colon's microbial community and the host cells [22]. Lee et al. have suggested that SCFAs are essential for preserving gut homeostasis and can boost the gut microbiota when taken as supplements [23].

Additionally, alterations in the gut microbiota do not always account for SCFAs' therapeutic effects on constipation. Based on Kang et al., the medicine that is used for the treatment of chronic constipation affects the GI of SCFAs but does not change the intestinal microbiota [24].

#### 5. Conclusion

In conclusion, Constipation is a prevalent gastrointestinal issue marked by infrequent bowel movements and difficulty passing stools. Various factors can contribute to constipation, eating a low-fibre diet, not getting enough exercise, being dehydrated, taking certain medications, and having a medical condition. For example, constipation could be attributed to conditions like IBS, an underactive thyroid, or a neurological issue. Hormonal shifts during pregnancy and menstruation may exacerbate constipation. Constipation can also be caused or exacerbated by the bacteria in the digestive tract (the gut microbiota).

Constipation can be prevented and treated by increasing fibre and water intake, becoming more physically active regularly, and consulting a doctor about any medications or medical conditions that may be a factor. Alterations to the gut flora can cause digestive issues, including constipation, which may be relieved by probiotics or prebiotics. In addition, Constipation can be alleviated with the help of Involving SCFAs, or short-chain fatty acids, contributing to preserving intestinal well-being, maintaining barrier integrity, and promoting the proliferation of beneficial bacteria. Additionally, dietary fibre is essential to a balanced microbiota in the digestive tract. Therefore, maintaining a diet rich in fibre and other beneficial nutrients is crucial in preventing and alleviating constipation.

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