Therapeutic approaches and challenges for modulating the microbiota to prevent adenoma colon cancer

Abhinandan Patil1, Neha Singh2, Nita Pawar3

1Department of Pharmaceutics, D. Y. Patil College of Pharmacy, Kolhapur, Maharashtra 416003, India. 2Department of Microbiology, Pt. JNM Medical Raipur, Chhattisgarh 492001, India. 3Department of Pharmaceutics, Bharati Vidyapeeth Institute of Pharmacy, Belapur, Navi Mumbai, Maharashtra 400614, India.

*Corresponding to: Abhinandan Patil, Department of Pharmaceutics, D. Y. Patil College of Pharmacy, Kadamwadi road, Kolhapur, Maharashtra 416003, India. E-mail: abhisirdyp@gmail.com.

Abstract

New research suggests that gut microbiota helps adenoma colon cancer spread worldwide. This study seeks therapeutic microbiota changes to prevent adenoma colon cancer and discusses their drawbacks. Prebiotics feed good bacteria and promote the formation of short-chain fatty acids, which have anti-inflammatory and anti-cancer properties. To promote healthy gut bacteria and reduce adenoma risk, fiber-rich diets and particular dietary interventions are being researched.

FMT (fecal microbiota transplantation) may help restore gut flora and prevent adenoma colon cancer, according to the study. FMT transfers healthy donor feces to patients to restore microbial diversity. Different gut flora, persons, and therapies make it tricky to draw conclusions. Personalizing therapeutic approaches to each person’s microbiota, host features, and genetic factors can improve treatment. Changing microorganisms may prevent adenoma colon cancer. Prebiotics, probiotics, dietary modifications, FMT, and bacteria metabolites may assist. More research is needed to determine the best ways to aid, solve difficulties, and personalize methods. We can prevent adenoma colon cancer and improve public health by learning more about gut flora and optimizing treatment methods.

Keywords: colon cancer; probiotics; adenoma; FMT
Introduction

People are paying more attention to probiotics and prebiotics because of their ability to change the gut flora and improve colorectal health. The gut bacteria are very important for keeping intestinal balance, and it has been linked to the development of adenoma colon cancer, which is a form of colorectal cancer that starts as a benign growth in the colon. Probiotics are live bacteria that help the health of the person when they are eaten in the right amounts. Prebiotics, on the other hand, are food grains that can’t be digested and that only help good bacteria grow and work in the gut [1, 2].

Colorectal cancer

It is also called bowel cancer or colon cancer, which is when abnormal cells in the colon or rectum grow out of control. It is a type of cancer that happens a lot around the world. Colorectal cancer is a type of cancer that starts in the lining of the gut or rectum and grows into a growth. It usually starts with small polyps that are not dangerous. Over time, these polyps can grow and turn into cancer. If the cancerous cells are not handled, they can move to nearby organs and other parts of the body. This is called metastasis.

Causes or etiology

No one knows for sure what causes colorectal cancer, but there are a few things that can make it more likely to happen [3, 4]: (a) Age: Colorectal cancer risk goes up with age, and most cases are found in people over 50. (b) Family history and genetics: If someone in your family has had colon cancer or if you have Lynch syndrome or familial adenomatous polyposis (FAP), your risk goes up. (c) People with a history of precancerous polyps or chronic inflammatory conditions like ulcerative colitis or Crohn’s disease are at a higher risk. (d) Lifestyle factors: A poor diet (one that is low in fiber and high in red or processed foods), being overweight, smoking, and drinking too much alcohol are all linked to a higher chance. (e) Previous pelvic radiation therapy can increase the chance of colorectal cancer.

How colorectal cancer starts

Most colorectal cancers start as benign polyps in the colon or rectum. Some of these polyps can get genetic changes over time that make them grow out of control and turn deadly. Adenocarcinoma, which starts in the glandular cells that line the inside of the colon and rectum, is the most common type of colorectal cancer. As the cancer cells grow, they can move into lower layers of the gut wall. Eventually, they can spread through the bloodstream or lymphatic system to nearby lymph nodes or organs far away. Most of the time, the liver and lungs are affected by colon cancer that has spread.

Epidemiology

Colorectal cancer is a major health problem around the world. The sickness happens and is found in different places around the world, with higher numbers in developed countries. From the info we have up to 2021, here are some important facts about its spread: (a) Colorectal cancer is the third most common type of cancer in the world. It makes up about 10% of all cancer cases. (b) Death: It is the second most common cause of death from cancer. (c) Age: The chance of getting colon cancer goes up with age, and most cases happen in people over 50. (d) Gender: Both men and women can get it, but men are more likely to get it. (e) Rates of occurrence range by country. In developed places like North America, Europe, and some parts of Asia, the rates are higher.

Colorectal cancer can be prevented and treated better if it is found early through screening and living a healthy life. If you have worries or risk factors, it’s important to talk to your healthcare provider about them so they can help you figure out the right screening and prevention methods.

Several studies have looked at how probiotics and prebiotics affect the gut flora and whether they could help stop adenoma colon cancer from happening. Scientists have found that probiotics like Lactobacillus and Bifidobacterium strains change the gut microbiota by increasing the number of good bacteria, decreasing the number of bad bacteria, and increasing the production of short-chain fatty acids, which have anti-inflammatory and anti-cancer properties. These benefits create a good environment in the gut, which may help stop adenoma colon cancer from starting or getting worse. Prebiotics are food for good bacteria in the gut. They include dietary grains like inulin, fructooligosaccharides, and resistant starch. They help good bacteria like Bifidobacteria and Lactobacilli grow, which leads to the production of chemicals that protect against adenomas that can cause colon cancer. Butyrate is one of these molecules. It gives colonocytes energy and has qualities that stop inflammation and prevent cancer. Even though there are some hopeful signs, researchers are still trying to figure out how probiotics and prebiotics protect against adenoma colon cancer. Also, more study is needed to figure out how to choose specific types, the best doses, and the length of time to treat with probiotics and prebiotics. In conclusion, probiotics and prebiotics may be able to change the gut flora and stop adenoma colon cancer from happening. More study is needed to better understand how they work, find the best ways to make them, and come up with evidence-based guidelines for how they can be used to avoid adenoma colon cancer [4–6]. Microbiota, especially probiotics, reduce the severity of colon cancer by controlling the inflammation, metabolite production, tumor microenvironment, cell proliferation and toxin production at the site of proliferation.

Reducing the impact of colon cancer with microbiota, especially probiotics

Recent studies have shown that the gut microbiota, and probiotics in particular, can have a major impact on colon cancer risk and progression. When taken in sufficient doses, probiotics are beneficial to the health of the host organism. These good bacteria are essential for a healthy gut microbiome and for keeping things like immune responses and homeostasis stable. Researchers have shown that probiotics help lessen the severity of colon cancer in a few different ways [7–11]:

One of the most important things you can do to prevent colon cancer is to reduce the inflammation that can cause precancerous lesions to grow into full-blown tumors. Anti-inflammatory effects of probiotics like Lactobacillus and Bifidobacterium strains have been studied extensively. Inhibiting pro-inflammatory cytokines and altering the function of immune cells, they can reduce chronic inflammation and protect against cancer (Figure 1).

The gut microbiota ferments dietary fibers and complex carbohydrates into short-chain fatty acids (SCFAs) including butyrate, which play a role in regulating metabolite production. Because they provide fuel for colonic cells and aid in keeping the colon’s lining in good condition, SCFAs are crucial to good colon health. In particular, studies have demonstrated that butyrate has anti-cancer effects by inducing apoptosis (programmed cell death) in cancer cells and reducing their ability to multiply. By increasing the synthesis of these helpful SCFAs, probiotics can foster a tumor-free colonic environment.

Tumor development and metastasis can be modulated by the gut microbiota through a process known as “modulation of the tumor microenvironment.” Anti-tumor immune cells, such as T cells and natural killer cells, can be encouraged to enter the tumor microenvironment thanks to probiotics. Tumor development and metastasis can be slowed by immune modulation as the body becomes better able to identify and destroy cancer cells.

The growth of colon cancer cells is directly inhibited by certain probiotics, which brings us to point number four. Some probiotic bacteria, such as Bifidobacterium and Lactobacillus, have been proven to inhibit the growth and spread of colon cancer by inducing cell cycle arrest and death.

Reducing the production of toxins is an important step in protecting against cancer since toxins produced by some pathogenic gut bacteria
can damage DNA and encourage tumor growth. The negative effects of these toxins on the colon can be mitigated by taking probiotics, which compete with pathogenic bacteria for nutrition and adhesion sites in the gut. As research continues to show that probiotics can help lessen the severity of colon cancer, more people are considering taking them as an adjunct therapy to standard cancer medicine. However, caution should be exercised while using probiotics in cancer patients, and consulting with medical specialists is required, especially for those receiving cancer therapies like chemotherapy and radiation therapy.

Gut bacteria, and probiotics in particular, have been shown to have a significant impact in lowering colon cancer risk. Modulating the tumor microenvironment, limiting cell proliferation, and lowering toxin production are just some of the ways in which probiotics might aid in the management of colon cancer. There is promising evidence that using probiotics in colon cancer preventative and treatment techniques can improve patient outcomes and the efficacy of colon cancer therapy as a whole. However, further study is needed to determine which probiotic strains, doses, and therapy protocols are most effective in combating colon cancer.

**Nutritional interventions**

Diet is a major factor in how the gut bacteria is made up and how it works, and new evidence shows that dietary changes can affect the growth and spread of adenoma colon cancer. Researchers have looked into how dietary changes, such as eating more fiber and certain nutrients, might help keep the gut bacteria healthy and lower the risk of polyp colon cancer [12–14].

Diets that are high in fiber, especially those that are high in fruits, veggies, whole grains, and legumes, are a good source of complex carbohydrates that are not fully digested in the upper GI system. These fibers make it to the colon in one piece, where they feed the good bacteria in the gut. Short-chain fatty acids like butyrate, acetate, and propionate are made when bacteria ferment food fiber. These acids have been linked to a lower chance of adenoma colon cancer. These short-chain fatty acids reduce inflammation, improve the function of the digestive barrier, and control how cells grow and change in the gut. Aside from fiber, certain nutrients have also been looked at to see if they might help protect against polyp colon cancer. For instance, polyphenols, which are found in plant-based foods like fruits, veggies, and tea, have been shown to change the makeup of the gut flora and prevent cancer. These chemicals have antioxidant and anti-inflammatory qualities, which may help lower oxidative stress and inflammation in the colon. Also, omega-3 fatty acids, which are found in foods like fatty fish, walnuts, and flaxseeds, have been linked to a lower chance of colon cancer, including the growth of adenomas. Omega-3 fatty acids have been shown to change gut bacteria and lower inflammation in the gut, which may contribute to their protective benefits. Even though there is more and more proof, more study is still needed to figure out how dietary changes affect the gut bacteria and affect the development of adenoma colon cancer. Also, more research is needed to find out the best types and amounts of fiber, antioxidants, and omega-3 fatty acids for gut health. In conclusion, dietary treatments, such as fiber-rich meals and specific nutrient interventions, show hope for promoting a healthy gut microbiota and lowering the chance of adenoma colon cancer (Figure 2). The protective benefits of these treatments may come from changing how the gut microbiota is made up, making good metabolites, and changing how inflammation works. But more study is needed to figure out the best ways to change your diet to lower your chance of adenomas leading to colon cancer and to learn more about how these changes work [15–17].

**Fecal microbiota transplantation (FMT)**

Fecal microbiota transplantation (FMT) is a treatment that includes moving feces from a healthy donor into the GI system of a sick person. This is done to restore a healthy mix of gut bacteria. FMT has gotten a lot of attention because it might be able to help a number of gastrointestinal problems. New research shows that it might also be able to avoid adenoma colon cancer by changing the gut microbiota [18–21].

Several studies have looked at how well FMT changes the makeup and function of the gut bacteria to stop adenoma colon cancer. It has been shown that FMT increases microbial diversity, brings back the number of helpful bacteria, and decreases the number of possibly dangerous bacteria in the gut of the recipient. This change in the bacteria is thought to make the gut environment healthy, lowering the risk of adenoma formation and growth. In clinical situations, FMT has been well-tolerated in terms of safety. But there are still worries about possible side effects, the spread of dangerous agents, and long-term effects. In order to make sure that FMT treatments are safe, strict donor screening processes, standard routines, and quality control measures are put in place. Even though the early study shows that FMT might help avoid adenoma colon cancer, more research is needed to find out if it is safe and effective in the long run. Randomized controlled trials and long-term follow-up studies are needed to find out when, how often, and how much FMT should be used to avoid adenomas. Also, it is important to find out how FMT affects the gut flora and bowel health. Overall, FMT shows promise as a way to treat gut bacteria that are out of balance and stop adenoma colon cancer. But more study needs to be done to fully understand how well it works, how safe it is, and what its long-term effects are. FMT has the ability to change how polyp colon cancer is prevented, but its benefits and risks need to be carefully weighed before it is used widely in clinical settings [22–25].

**Bacteria metabolites with short-chain fatty acids**

Microbial compounds, especially short-chain fatty acids (SCFAs), are important for keeping the digestive environment healthy and have been linked to preventing adenomas from turning into colon cancer. SCFAs are made when good bacteria in the gut break down food proteins and resistant starch. They give energy to the epithelial cells of the gut and protect the digestive mucosa in different ways. Studies have shown that SCFAs like butyrate, acetate, and propionate have anti-inflammatory, anti-proliferative, and pro-apoptotic qualities that can help control cell growth, keep the epithelial barrier intact, and change immune reactions in the colon. Their ability to associate with specific receptors on colonic epithelial cells and immune cells, which changes signaling pathways involved in cell growth, division, and
death, is thought to be responsible for these effects. Also, SCFAs have been shown to have effects on the immune system by driving the growth of regulatory T cells and calming down too much inflammation in the gut. This is a key part of avoiding chronic inflammation, which is a big risk factor for the development of adenoma colon cancer. Targeting bacteria compounds, especially SCFAs, as a way to avoid adenoma colon cancer seems like a good idea. Strategies that try to boost SCFA production through dietary changes, like eating more fiber or taking a prebiotic pill, could help improve the gut flora and boost SCFA production. Also, using therapies made from microorganisms or drugs that target SCFA receptors could be a new way to stop adenosomas from forming or getting worse. But it's important to remember that the effects of microbial molecules, like SCFAs, are complicated and rely on the situation. More research needs to be done on the best amounts, ratios, and relationships of SCFAs and other microbial compounds in the gut. Also, differences in each person’s microbiome and genetics may affect how they react to SCFAs and whether or not they can help avoid adenoma colon cancer. In conclusion, bacteria molecules, especially SCFAs, have become important in keeping the health of the colon and avoiding adenoma colon cancer. Their ability to reduce inflammation, stop cell growth, and change the immune system makes them good treatment targets. But more study is needed to find out their exact ways of working, the best ways to control their production, and how safe and good they are at preventing adenoma colon cancer in different groups of people [26–31].

Dissecting the complex interplay of dysbiosis and microbiota in colon cancer

One of the most common and deadliest forms of cancer, colon cancer results from a complex interaction between genetic predisposition and environmental triggers. The gut microbiota has an important role in colon cancer formation and progression, as recent studies have shown. The discovery that dysbiosis, the disturbance of the natural balance of microbial populations within the gut, may contribute to colon carcinogenesis, provides new opportunities for studying and maybe treating this fatal illness. The details of the same are as follows [32–36]:

**Colorectal health and the microbiota.** The bacteria that live in the human colon are called the gut microbiota. The health of the entire body is affected by the activities of these bacteria because of their involvement in digestion, nutrition metabolism, and immunological control. Maintaining homeostasis requires a balance between the host and its microbiome.

**Dysbiosis, the balance disturbance.** Diet, lifestyle, antibiotics, and disease are only a few of the causes of dysbiosis, which is defined as changes in the composition and function of the gut microbiota. The possible effects of dysbiosis on inflammation, immunological responses, and the gut barrier in the setting of colon cancer have gained a lot of interest.

**Inflammation and dysbiosis.** Colon cancer, like many others, is characterized by chronic inflammation. Inflammation can be triggered by dysbiosis in a number of ways: (1) Variations in bacterial makeup: Overgrowth of specific pro-inflammatory bacterial species can result in dysbiosis and cause persistent gut inflammation. (2) Metabolites with changes in inflammation and epithelium-promoting chemicals produced by dysbiotic bacteria may foster an environment favorable to cancer growth.

**Immune responses and dysbiosis.** The intestinal microbiota is crucial in shaping the immune system through learning. This delicate equilibrium can be upset by dysbiosis, which may then cause abnormal immunological responses: (1) Immune system stimulation: The immune system may become overactive in response to dysbiotic alterations, which may then contribute to carcinogenesis through an inflammatory environment. (2) Immune tolerance: The immune system’s ability to identify and manage malignant cells may be compromised by dysbiosis.

Dysbiosis has been linked to colon cancer, although the causes and effects of both are complex and varied. (1) Carcinogenesis promotion: Increased DNA damage and tumor development have been linked to the presence of several bacterial species, including specific strains of Escherichia coli. (2) Benefits for safety: The anti-inflammatory characteristics of butyrate-producing species and other beneficial bacteria may help to prevent these cancer-promoting activities. (3) Dietary interactions: The effect of dietary factors like fiber or high-fat diets on colon cancer risk may be modified by dysbiosis.

The discovery of a causal link between dysbiosis and colon cancer has important implications for both basic science and clinical practice.

First, identifying possible biomarkers for early diagnosis of colon cancer by the identification of distinct microbial fingerprints linked to the disease.

**Therapeutic procedures.** Potentially useful strategies for preventing and treating colon cancer include modifying the gut microbiota using probiotics, prebiotics, or dietary changes. Taking into account an individual’s microbiome composition may lead to more effective methods of controlling colon cancer risk. Colon cancer, dysbiosis, and the gut microbiota are all pieces of a puzzle that are currently being pieced together. Despite dysbiotic possible role in colon cancer, the situation is complex. To get ground-breaking insights into colon cancer prevention and management, researchers need a better knowledge of the microbial actors, their interactions, and the impact they have on inflammation, immunology, and metabolism. An emerging participant in this ever-changing field, the gut microbiota presents both obstacles and possibilities in our quest to understand colon cancer and its links to the microbiome [37].

**Problems and plans for the future.** Changing the gut microbiota to avoid adenoma colon cancer is a good idea, but it needs to be improved in a few ways to reach its full potential. Understanding these problems and figuring out where to go from here is important for advancing study in this area and turning it into useful ways to keep people from getting sick. One big problem is
that the gut microbiome is very complicated and different from person to person. The makeup of microbiota is different for each person and can be affected by things like food, habits, genetics, and environmental stressors. Getting a full understanding of the microbial patterns that are linked to adenoma colon cancer and finding the most important microbes to target for treatment are ongoing problems. Also, figuring out how different bacteria species and their molecules work together and how they contribute to colorectal carcinogenesis is a complicated job that needs more research [38-41].

Another problem is that we don’t know much about the best ways to use therapy to change the microbiome. Probiotics and prebiotics may help keep the bacteria in the gut healthy, but how well they work depends on the type, the dose, and how each person responds. To avoid adenoma colon cancer, more study is needed to find the best probiotic strains, prebiotic compounds, and specific treatment plans. Standardizing treatments and coming up with good plans for clinical trials are also big problems. To find out if microbiota-modulating strategies work, are safe, and have long-term benefits on preventing adenoma colon cancer, large-scale, well-designed clinical studies are needed. Also, finding accurate biomarkers that can predict how a treatment will work and track changes in the makeup and function of microbiota would make it much easier to build and keep track of preventive measures. Future study should also look into new ways to improve the specificity and effectiveness of microbiota modulation for preventing adenoma colon cancer, such as focused drug delivery methods, microbial-based therapies, and precision medicine techniques. By using modern tools like multi-omics approaches, high-throughput sequencing, and computational models, we will be able to learn more about how the microbiota works and how it affects the health and sickness of the host. In conclusion, changing the gut microbiota to avoid adenoma colon cancer has a lot of promise, but there are still some problems and limits that need to be worked out. By tackling these problems and focusing on future research directions, like understanding the unique microbiota signatures of each person, optimizing therapeutic strategies, standardizing clinical trials, and looking for new ways to do things, we can learn more and come up with effective ways to prevent adenoma colon cancer [42-44].

Discussion

The talk part of the study on changing the microbiota to avoid adenoma colon cancer gives an in-depth analysis and explanation of the results. It tries to put the results into the context of what has already been written, figure out what the most important outcomes are, and talk about any problems or areas for more study. One of the main points of this study is that probiotics and prebiotics might be able to change the gut flora in ways that could avoid adenoma colon cancer [45]. Evidence shows that certain strains of probiotics can help keep a healthy mix of microorganisms and improve the function of the gut barrier. This may help stop adenoma from forming. On the other hand, prebiotics provide food for good bacteria, which helps them grow and make short-chain fatty acids, which are good for reducing inflammation and fighting cancer. But it’s important to remember that the effectiveness of probiotics and prebiotics can vary based on the strains, amounts, and reactions of each person. This shows that more study is needed in this area. Dietary treatments also show promise as a way to change the gut flora and avoid adenoma colon cancer [46]. Researchers have found that fiber-rich foods and certain nutrient treatments, like polyphenols and omega-3 fatty acids, are linked to healthy gut microbiota and a lower chance of colorectal neoplasms. These dietary changes not only give the gut microbiota the nutrients it needs, but they also encourage a wide microbial community, which is thought to help keep the gut healthy and lower inflammation.

Fecal microbiota transplantation (FMT) is a new way to repair healthy gut bacteria and stop adenomas from turning into colon cancer. FMT tries to return helpful microbes and restore microbial diversity by giving patients the feces of healthy volunteers. Few studies have been done, but they show that FMT may help prevent adenoma from coming back [47]. However, more research is needed to find out if it works and if it is safe in the long run. The importance of microbial molecules, especially short-chain fatty acids (SCFAs), in colon health and preventing adenomas is also talked about in depth. SCFAs are made by bacteria in the gut when fibers are fermented. They have been shown to reduce inflammation and stop tumor growth in the colon. They help keep a healthy barrier in the gut, change how the immune system responds, and stop tumor cells from growing. Understanding how SCFAs and other microbial molecules work can help us figure out if they could be used as treatment targets to avoid adenoma colon cancer. Even though the results look good, there are some problems and limits that need to be taken into account. The diversity and complexity of the gut microbiota, the differences between people, and the lack of standard treatments make it hard to come to a clear decision. The different study designs, sample sizes, lengths of interventions, and ways of measuring outcomes make it hard to compare and generalize the results [48]. For strong proof and clear suggestions, treatments must be standardized, study designs must be rigorous, and a wide range of people must be included in the studies. The discussion also shows how important individual methods of microbiota modulation are for preventing adenoma colon cancer. Each person holds a unique microbiota makeup and reaction to interventions. Taking into account each person’s microbiota makeup, host traits, and genetic factors can make treatments more successful and allow for personalized prevention plans. By combining modern tools like metagenomics, metatranscriptomics, and metabolomics, we can learn more about how the microbiota and host interact with each other and make it easier to make personalized interventions. In the end, the talk focuses on how microbiota modulation could be used to avoid adenoma colon cancer. Probiotics, prebiotics, food changes, FMT, and focusing on bacteria metabolites are all possible ways to help. But more study is needed to find the best strains, dosages, and treatments, as well as to find out what the problems and limits are in this area. By learning more about the role of the gut bacteria in adenoma colon cancer and better treatment methods, we can make big steps toward lowering the number of people who get this disease and improving public health [49].

Conclusion

In conclusion, changing the gut microbiota to avoid adenoma colon cancer is a field that is growing quickly and has a lot of promise to improve the health of the colon. The studies that are talked about in this review show how important the gut microbiota is to the development and spread of adenoma colon cancer. They also show how the microbiota can be changed to help avoid cancer. Probiotics, prebiotics, dietary changes, fecal microbiota transplants, and targeting microbial molecules have all shown promise in changing the gut microbiota and lowering the risk of adenoma colon cancer. But there are some problems and restrictions in this field. The complexity and diversity of the gut microbiome, as well as the fact that it varies from person to person, make it hard to find microbial markers and figure out how they work. For strong evidence-based suggestions, it is important to standardize treatments, plan clinical trials, and find reliable biomarkers. Personalized methods that take into account each person’s microbiota makeup and host traits may also make interventions more successful. To move this area forward, future study should focus on solving these problems and looking for new ways to do things. Microbiota-modulating interventions need to be tested in large-scale, well-designed clinical studies to find out if they work, if they are safe, and what their long-term benefits are. Advanced tools and multi-omics methods can help us learn more about how microbes interact with each other and with their hosts, as well as how microbial chemicals work. This information can help with the development of tailored interventions and other methods for precision medicine. Overall, changing the gut flora is an exciting way to stop adenoma colon cancer from happening. By overcoming the problems, improving therapeutic approaches, and learning more about how the microbiota and the host interact, we can use microbiota modulation as a preventive strategy and help reduce the number of people with...
adenoma colon cancer all over the world.

References
40. Patil A. Psychology in the Age of Technology Dependence and the Mobile Dilemma. Preprints 2023;2023070101. Available at: https://doi.org/10.20944/preprints202307.0101.v1
41. Patil A, Kotekar D, Chavan G. Knowing the Mechanisms: How Probiotics Affect the Development and Progression of Cancer. Preprints 2023;2023070243. Available at: https://doi.org/10.20944/preprints202307.0243.v1