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2.3 Connection between diet rich in animal fat and inflammatory bowel diseases

"What lies behind us and what lies ahead of us are tiny matters compared to what lies within us." -Henry S. Haskins

The rate of cases of inflammatory bowel diseases are increasing day by day and leading to gastrointestinal discomfort even after following treatment. It can affect an individual in a variety of ways from symptomatically pain, nausea, flatulence to decrease in working efficiency and mood imbalance as well. So, the most common question asked is what do I eat for a healthy, painless gut preventing inflammatory bowel diseases.

Necessary studies have been carried out linking high fat diet like meat progressing to gastrointestinal problems, whereas as dietary fiber, carbohydrates and fruits have been found to be protective. There have been cited a number of reasons for this fact. One reason why specifically animal protein was associated with triple the risk of inflammatory bowel disease, but plant protein was not, is because it can lead to the formation of toxic bacterial end product, hydrogen sulfide. Hydrogen sulfide is a poison that has been implicated in ulcerative colitis. It's production in the bowel increases the risk of irritable bowel, inflammatory bowel disease, and eventually, colorectal cancer. [128] Hydrogen sulphide is mainly produced by sulfate-reducing bacteria which are generally normal commensals of the bowel. Sulfate and sulfite serve as food preservatives and antioxidants in the production of bread, meat, wine and dried fruits. Dietary supplement chondroitin and food additive carrageenan also contain sulfate. It was observed that higher dietary intake of these foods lead to higher incidence of UC. Hydrogen sulphide inhibits butyrate oxidation. Colon epithelium are getting 70% of its energy from the butyrate derived from intestinal substrates fermentation of non-starch polysaccharides by colon bacteria. That is the reason why energy deficiency is often connected with the prevalence of UC [129].

One such study done by M A Chapman 1, M F Grahn, M A Boyle, M Hutton, J Rogers, N S Williams in role of butyrate in inflammatory bowel syndrome was as follows. [130]

Triplicate biopsy specimens were taken at colonoscopy from five regions of the large bowel in 15 sufferers of ulcerative colitis. These patients all had mild or quiescent colitis as assessed by clinical condition, mucosal endoscopic and histological appearance. The rate of oxidation of glucose, glutamine, and butyrate through to carbon dioxide was compared with that in biopsy specimens from 28 patients who had no mucosal abnormality. Butyrate was the preferred fuel source for the colon mucosa followed by glutamine and then glucose. There was no regional difference in the rate of utilization of these metabolites. In the group with colitis the rate of butyrate oxidation to carbon dioxide was significantly impaired compared with that in normal mucosa. The rate of glucose and glutamine utilization were not significantly different between normal and colon mucosa. These data confirm that in quiescent ulcerative colitis there is an impairment of butyrate oxidation.[130].

Another reason for development of Inflammatory bowel can be infection with *Yersinia. Yersinia* can live in the intestines of animals including pigs, cows, sheep, horses, dogs, cats, rodents and birds as well as humans. When animals are slaughtered and butchered for food, bacteria from an animal's intestines may contaminate the meat that we consume. Common sources of infection are undercooked pork and other meats.[131]

In treating the Inflammatory bowel disease, the basic 'triple' therapy (5-aminosalicylates, corticosteroids, azathioprine) and nutrition have maintained their central role in the management of patients with inflammatory bowel disease over recent decades.[132]. However, excluding the animal fat out of the diet speeds up the process even better than medication therapy itself. High fat intake after successful treatment by medication can undone all the benefits of treatment and onset of symptoms again. Hence the fat free diet plays a vital role in prevention as well as cure of inflammatory bowel disease. The Nutrition therapy is acceptable, cost effective and free from adverse effects. Dietary intervention studies have shown that enteral therapy, with defined formula diets, helps children with Crohn's disease and reduces inflammation and dysbiosis. Soluble fiber is the best way to generate short-chain fatty acids such as butyrate, which has anti-inflammatory effects. Addition of vitamin D and curcumin has

been shown to increase the efficacy of IBD therapy. There is compelling evidence from animal models that emulsifiers in processed foods increase risk for IBD. [133]

Also, there is very strong evidence supporting the use of certain probiotics and prebiotics in the therapy of ulcerative colitis. Prebiotics are non-digestible food ingredients that selectively stimulate favorable bacterial growth and/or promote activity of a limited number of health-promoting bacteria, hence benefiting the host. Probiotics are specific live microorganisms which, when ingested in sufficient amounts, can promote health in the host. When probiotics and prebiotics are combined in one product to achieve synergistic effects they are usually called synbiotics. Probiotics and prebiotics achieve their therapeutic effect in IBD through many different mechanisms. By increasing the production of short-chain fatty acids, they may lower the pH of the colonic environment and thus inhibit the growth of potentially pathogenic microorganisms.[134]

A study carried out by, Jason K Hou 1, Bincy Abraham and Hashem El-Serag in which nineteen studies were included, encompassing 2,609 IBD patients (1,269 Crohn's disease (CD) and 1,340 ulcerative colitis (UC) patients) and over 4,000 controls. Studies reported a positive association between high intake of saturated fats, monounsaturated fatty acids, total polyunsaturated fatty acids (PUFAs), total omega-3 fatty acids, omega-6 fatty acids, mono- and disaccharides, and meat and increased subsequent CD risk. Studies reported a negative association between dietary fiber and fruits and subsequent CD risk. High intakes of total fats, total PUFAs, omega-6 fatty acids, and meat were associated with an increased risk of UC. High vegetable intake was associated with a decreased risk of UC.[135].

Fats, meat and poultry are important sources of n-6 Polyunsaturated fatty acids, which subsequently increases the risk of inflammatory bowel disease. Prospective studies on European cohorts, mainly including middle-aged adults, suggest that a diet high in protein from meat and fish is associated with a higher risk of inflammatory bowel disease. Intake of the n-6 polyunsaturated fatty acid linoleic acid may confer risk of ulcerative colitis, whereas n-3 polyunsaturated fatty acids may be protective. No effect was found of intake of dietary fibres, sugar, macronutrients, total energy,

vitamin C, D, E, Carotene, or Retinol (vitamin A) on risk of ulcerative colitis. No prospective data was found on risk related to intake of fruits, vegetables [136][137]. Educational hospitalization, which can be done for treating patients of inflammatory bowel disease, means bringing patients into the hospital to control their diet and educate them about the benefits of plant-based eating, so they'd be more motivated to continue it at home. Most patients, about three-quarters, experienced improvements such as disappearance or decrease of symptoms during hospitalization. Maintaining this diet after discharge, these patients were able to control the disease over years.

We already know that a diet consisting of whole grains, legumes, fruits, and vegetables has been shown to be helpful in the prevention and treatment of heart disease, obesity, diabetes, hypertension, gallbladder disease, rheumatoid arthritis, and many cancers, well, inflammatory bowel diseases might as well be added to that list.

Also, eating a Western diet impairs the immune system in the gut in ways that could increase risk of infection and inflammatory bowel disease, according to a study from researchers at Washington University School of Medicine in St. Louis and Cleveland Clinic. The Western pattern diet (WPD) is a modern dietary pattern that is generally characterized by high intakes of red meat, processed meat and pre-packaged foods [138]. One of the ways a high fat diet may influence immunity is its effect on Paneth cells. Paneth cells are immune cells in the gut that are responsible for keeping inflammation in check. Researchers looked at data on 400 people and assessed their Paneth cells. They found that Body Mass Index (BMI) played a factor in the cells. The higher a person's BMI, the worse their Paneth cells looked.

Researchers then fed healthy mice a western diet to see if it changed Paneth cell activity. It did, causing them to suggest that it wasn't obesity, per se, that led to problems, but a high fat diet. Paneth cells in mice returned to normal after being fed a healthy diet for a couple of weeks. There could be several factors that contribute to gut inflammation and IBD, but this data sends a strong signal that diet is part of it. Eating a western-style diet, rich in processed foods and fat and sugar, may impair the immune system and increase the risk for IBD [139].When these cells become impaired, the gut becomes more prone to inflammation, and the risk for inflammatory bowel disease

increases. Poorly, or non-functioning Paneth cells, for example, are a key feature of Crohn's disease.

Recent reports on IBD therapy that replaced westernized diets with plant-based diets achieved far better outcomes than those previously reported in the literature. Westernized diet-associated gut dysbiosis is the most ubiquitous environmental factor in IBD. Quitting western diet have the potential to provide a better quality of life for patients with IBD. Replacing Animal Protein with Soy-Pea Protein in the western diet have shown to control the inflammatory bowel disease. In a study, when western diet animal protein was replaced with soy-pea protein, it resulted in lower histology scores in all feeding trials and IBD mouse models than did other diets. Compared with the western diet, the soy-pea correlated with increased abundance in Lactobacillaceae and Leuconostraceae, glutamine and butyric acids, and decreased linoleic acid. Hence, replacement of animal protein in a western diet by plant-based sources reduced the severity of experimental IBD in all mouse models studied, suggesting that similar adjustments to the daily human diet could help control/prevent IBD in humans [140].

So, the question can be, is there any special diet for inflammatory bowel disease? Well, there is not a specific diet for inflammatory bowel diseases but many diet plan have been found to be effective. There are many diets which are popularly prescribed which includes (1). Elimination Diet- An elimination diet functions as a test, determining whether patients may have a sensitivity to certain foods. Initially, patients stop eating foods suspected of causing illness. Then, after a suitable period of time (often 10–14 days), they review the patients' symptoms. (2).Low-fiber with Low-residue Diet - Minimizes the intake of foods that add bulk residue to stool (e.g., raw fruits, vegetables, seeds, nuts). Often used in patients with strictures or during flares. May be restricted in certain vitamins, minerals, and antioxidants. Needs monitoring. (3) Total Bowel Rest- Period of complete bowel rest during which patients are nourished with fluids delivered intravenously. (4) Clear Liquid Diet- The clear liquid diet supplies fluids and energy from foods that require very little digestion. The clear liquids reduce bowel residue and provide fluids to ease thirst. (5) Elemental Diet - Consists of nutrients in their simplest form. High in carbohydrates, low in fats. Used

in Europe as primary treatment for CD, but not considered as good as other treatments. (6) FODMAPs (Fermentable, Oligo-, Di- and Mono-saccharides, and Polyols) - Diet minimizes consumption of these fermentable carbohydrates to manage GI symptoms, including diarrhea, gas, and bloating. More commonly used for IBS. (7) South Beach Diet™ and Atkins Diet™ Both South Beach and Atkins diets restrict carbohydrates. Very strict diet at beginning followed by long-term eating plan. Decreases complex carbohydrates which may affect bowel function. (8) The Maker's Diet - Focuses on four components of total health- physical, mental, spiritual, and emotional. Consists of a phased approach. Recommended foods are unprocessed, unrefined, and untreated with pesticides or hormones. These are various diets for aimed to heal and treat inflammatory bowel diseases by limiting the entry of high fat products into the colon mucosa.

Thus, decrease in intake of high fat animal protein diet, and significantly having a diet based on plant-based carbohydrates and fibers plays a major role in prevention, treatment as well as post treatment measures of inflammatory bowel disease.