Abstract. – High consumption of potatoes, soft drinks, cornflakes, chocolates, mushrooms and other common examples of complex carbohydrates in the western side of the globe is significant. Similarly, Inflammatory Bowel Diseases (IBD) (Crohn’s disease and ulcerative colitis) are also prevalent in these regions.

Evidence exists to support that factors, such as lack of zinc (it is common in patients with IBD, in particular Crohn’s patients) may significantly affect the activity of some enzymes, such as, disaccharidases and other digesting enzymes of carbohydrates and that would lead to the recruitment of incompletely digested carbohydrates to the terminal ileum and continual stimulation of the immune-response accordingly. This concept may explain the observation of the existence of higher significant percentage of severe disease in Caucasian patients with IBD comparable with the respected Asian patients who consume less.

Key Words:
Complex carbohydrates, Outraged immune-response, Caucasians, Inflammatory Bowel Diseases, Epidemiology.

Introduction

Inflated immunological response is a well recognized manifestation of inflammatory bowel diseases (Crohn’s disease & ulcerative colitis). This feature is quite significant in Caucasians, then in Africa-Carribbeans and least in Asians. No clear aetiology is known for this disorder. Similarly, high consumption of refined carbohydrates is well documented in Caucasian patients with inflammatory bowel diseases (IBD).

Further, it is well known that external environment, which includes native mucosal microbiota, potential pathogenic microorganisms, abundant food antigens, and allergens (all of which are encountered on the vast surface areas of mucosal membranes) forms the most important source of stimulation of the entire immune system. Whether high consumption of carbohydrates plays some role in the induction and/or promotion of this documented aggressive immune-response in subjects with inflammatory bowel diseases or not is unclear.

The Hypothesis

We hypothesize that “the well documented inflated immune-response in subjects with inflammatory bowel diseases is partly due to high ingestion of carbohydrates”.

For assessing the credibility of this theory, we have to examine this subject from different angles:

High Consumption of Carbohydrates and Inflammatory Bowel Diseases and its Implications

Increased consumption of refined carbohydrates has been significantly recorded in patients with inflammatory bowel diseases1-15. Drinking soft drinks with meals is also a significant character of life in Western countries where these diseases are prevalent. The sugar concentrations in different soft drinks varies between 10% and 14%. In practical terms this amounts to 10-12 average-sized teaspoons of sucrose per 500 ml bottle of cool drink16. Furthermore, our Caucasian patients with Crohn’s disease have reported their eagerness to eat chocolates and other sweets regularly before, after and in between their regular meals.

The principal dietary carbohydrates are polysaccharides, disaccharides, and monosaccharide17. Starches (glucose polymers) and their derivatives are the only polysaccharides that are digested to any degree in the human gastrointestinal tract.
Amylopectin, which constitutes 80-90% of dietary starch, is a branched molecule, whereas amyllose is a straight chain with only 1:4 linkage. The disaccharide lactose (milk sugar) and sucrose (table sugar) are also ingested, along with the monosaccharide fructose and glucose.

It is well known that hexoses are rapidly absorbed across the wall of the small intestines. Essentially all the hexoses are removed before the remains of a meal reach the terminal part of the ileum. Yet, it was found that mucosal enzymes such as alkaline phosphates and disaccharides had lower activities in zinc-deficient rats than in controls and that the alterations were not due to changes in intestinal micro flora.

The sugar molecules pass from the mucosal cells to the blood in the capillaries draining into the portal vein. The transport of most hexoses is dependent on Na+ in the intestinal lumen; a high concentration of Na+ on the mucosal surface of the cells facilitates and a low concentration inhibits sugar influx into the epithelial cells. This is because glucose and Na+ share the same co-transporter or symport.

The major interface between internal organs and outside environments is the columnar intraepithelial cell layer in the gastrointestinal tract. In addition to epithelial cells, the columnar epithelium includes a population of lymphocytes termed intraepithelial lymphocytes. These intraepithelial lymphocytes reside between the basolateral surfaces of epithelial cells. It has been estimated that one intraepithelial lymphocyte can be found for every six epithelial cells, which indicates that large number of lymphocytes are situated in the intestinal mucosal tissues. These lymphocytes are continuously exposed to antigens ingested via the epithelial layer. It is sensible to assume that intraepithelial lymphocytes are important lymphoid cells that participate in the induction and regulation of the mucosal immune response.

In general, the majority of human and murine intraepithelial lymphocytes are classified as T cells because they express the CD3 molecules in association with other two forms of T cell receptors (TCRs): γδ and αβ. With regard to the expression of CD4 and CD8 by intraepithelial T cells, it has been found that approximately 80% of these cells belong to the CD8 subset. However, a substantial number of intraepithelial lymphocytes can be grouped as CD4-bearing cells, including CD4+ CD8- and CD4+ CD8+ subsets.

The occurrence of large number of CD8+ T cells among intraepithelial lymphocytes is distinct from the case of T cells residing in other lymphoid tissues.

Evidence exists from studies on ulcerative colitis’ subjects, to prove the presence of a highly preserved T cell receptor (TCR) pattern among intestinal CD8+ T cells in the majority of ulcerative colitis (UC) patients undergoing colectomy that was not present in normal control individuals. However, this TCR motif did not significantly discriminate active from inactive disease states. The persistent and diffuse nature of this TCR-associated design in UC suggests that an ongoing T-cell response to a particular antigen(s) is occurring in this disorder.

In addition, intraepithelial lymphocytes from patients with Crohn’s disease showed significant increase in catalytic activity against epithelial-derived target cells when compared with intraepithelial lymphocytes from control patients. In contrast, no functional changes were found among peripheral blood lymphocytes from patients with Crohn’s disease. Intraepithelial lymphocytes from patients with Crohn’s disease contained a significant higher percentage of CD8+ lymphocytes when compared with intraepithelial lymphocytes from control patients, whereas no phenotypic changes were observed among peripheral blood lymphocytes.

Furthermore, published reports demonstrate that inhibition of recruitment of CD8 T cells would have beneficially effect.

**Disease Activity and Sugar Consumption**

Evidence exists to prove the presence of a positive link between ingestion of carbohydrates and disease activity in subjects with inflammatory bowel disease.

In 1981, Brandes and Lorenz-Meyer reported the outcome of their randomized controlled trial. The aim of their study was to assess the efficacy of low carbohydrate diets in controlling disease activity in cases of Crohn’s disease.

In this study, the researchers divided 20 patients with mild to moderate Crohn’s disease into two subgroups. The first group received a low carbohydrate diet with free refined sugar for 18 months. But the second group was given high carbohydrate diet containing rich refined sugar for the same period. For the two groups, drug treatment was passed over 14 days before commencement of the study.

In five patients with Crohn’s Activity Index ranged between 100-200 points, and who re-
received low carbohydrate diets with no refined sugars, the activity index of the disease decreased in four of them (80%) and their condition stabilized during the period of the study.

**Complex Carbohydrates and Immunological Response**

Recent development in glycobiology have shown that carbohydrates play an important part in diverse immunological process, such as opsonisation and phagocytosis of microorganisms, and cell activation and differentiation. Carbohydrates exert their function through interaction with carbohydrate-binding proteins or lactins, which are widely distributed in mammalian tissues including those of the immune system. Glucans, for example, are (1-3)-β-D-linked polymers of glucose that are produced as fungal cell wall constituents and are also released into the extracellular milieu. Glucans modulate immune function via macrophage participation. The first step in macrophage activation by (1-3)-β-D-glucans is thought to be the binding of the polymer to specific macrophage receptors. Intravenous injection of purified glucan in rodents result in an increase in liver and spleen weight attributed to increased macrophage activity. This likely because glucan enhances production of several cytokines such as GM-CSF, IFN-gamma, TNF-alpha and IL-12p70, but not IL-6. GM-CSF plays a key biological role in this by increasing the number of macrophages and granulocytes in the spleen.

Macrophages from glucan treated mice are larger than controls, and attach and spread more rapidly on glass. These same macrophages showed augmentation of their chemotactic activity. Spleen cells from glucan-treated mice elicited a much more severe graft-versus-host reaction in recipient animals than do cells from normal mice.

Administration of glucan to irradiated mice prior to bone marrow transplantation had no effect on syngeneric bone marrow grafts but may prevent acceptance of allogeneric or xenogenic bone marrow.

It is important to note that β-glucan, for example, is found in the cell walls of many yeast and cereal fibres, such as oats, wheat, and barley. And the daily consumption of cereals is an epidemic phenomenon in the western side of the globe where inflammatory bowel diseases are prevalent. Mushrooms are highly consumable in these areas as well.

**Asian Patients with Inflammatory Bowel Diseases and Carbohydrate Consumption**

Our studies on Asian immigrants from other countries to the United Kingdom and who have been diagnosed with inflammatory bowel disease long time after their movement revealed that the majority of the participants’ consumption of plain sugar was within normal limits (average 10-20 g per day), they, scarcely ate sweets, cakes and chocolates, and their ingestion of soft drinks were occasional. Their disease was mainly classified as mild to moderate.

**Conclusion**

The presented hypothesis in this paper assumes positive link between high consumption of carbohydrates and outraged immunological responses in inflammatory bowel diseases’ patients (cause-effect relationship).

**References**


