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A LOW FODMAP DIET TOOL KIT FOR REGISTERED DIETITIANS TO USE IN THE DIETARY TREATMENT OF IRRITABLE BOWEL SYNDROME.

A Project

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ABSTRACT

A Low FODMAP Diet Tool Kit for Registered Dietitians to use in

the Dietary Treatment of Irritable Bowel Syndrome.

By

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The purpose of this project is to develop a resource for use by registered dietitians in the treatment of irritable bowel syndrome (IBS). Irritable bowel syndrome occurs in roughly 15 % of the United States (U.S.) population and results in increased absence from work, reduced productivity, and increased health costs. Psychological, emotional and/or dietary factors are thought to be drivers of IBS. A growing body of evidence is demonstrating the effectiveness of a low Fermentable Oligosaccharides, Disaccharides, Monosaccharide, And Polyols (FODMAP's) diet in treating IBS. These fermentable, short-chain carbohydrates that can contribute to the chronic symptoms due to the way in which FODMAP's can be malabsorbed. In controlled trials, the implementation of a low FODMAP diet resulted in an average 76% improvement in symptoms. Registered Dietitians will benefit from this knowledge and be able to use this tool kit to help their IBS patients adopt a low FODMAP diet.

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CHAPTER 1

Introduction

Irritable bowel syndrome (IBS) is the most common intestinal problem that causes people to be referred to a gastroenterologist (Irritable bowel syndrome, 2011). Those who suffer from this condition often have increased absenteeism from work, decreased productivity, increased health care costs and a decreased quality of life as they cope with their symptoms. This condition is characterized by chronically recurring manifestations of abdominal pain, changes in bowel habits (e.g., constipation or diarrhea), bloating, and flatulence. Currently there are no specific tests to qualify an individual as having IBS, however certain diagnostic tests may be completed to rule out other digestive disorders. If these test results are negative, the doctor may diagnose the patient as having IBS based on the Rome III criteria for the condition and the absence of other diseased states (Escott-Stump, 2012). The diagnostic criteria requires the patient to have had at least three days per month for the past three months of continuous or recurrent symptoms of abdominal discomfort relieved with defecation or associated with a change in stool frequency or stool consistency. Certain symptoms must also be present, such as: feelings of uncontrollable urgency to have a bowel movement; difficulty or inability to pass stool; mucus in stool; and/ or bloating (National Institute of Health [NIH], 2007).

The etiology for IBS is unknown. While the predominant underlying cause of symptoms appear to reside in the enteric nervous system manifesting as visceral hypersensitivity and/or motility disturbances, multiple other factors may contribute to

symptom generation, including psychological trauma, environmental factors, and/or dietary drivers (Gibson & Shepherd, 2010).

Current medical treatment for IBS focuses on the specific gastrointestinal (GI) dysfunction presented, such as constipation, diarrhea, abdominal discomfort. Medication is primarily used when nonprescription remedies do not work or when symptoms are severe. The medications focus on nerve-gut communication dysfunction as well as population control of bacteria in the gut, such as with antibiotics used in certain cases to address possible Small Intestinal Bacterial Overgrowth (SIBO). Newer agents that continue to be used and evaluated include those that affect how the GI tract responds to the neurotransmitter serotonin, which regulates intestinal movements among other functions (Beyer, 2008).

Numerous approaches to dietary management of IBS have been investigated (Staudacher, Whelan, Irving, & Lormer, 2011). Modification of dietary fiber has been a mainstay treatment of IBS management for many years (Brandt et al., 2002; Bijkerk , Muris, Knottnerus, Hoes & de Wit, 2004, Ford et al., 2008). Fiber is marginally beneficial; insoluble fiber may worsen symptoms but soluble fiber may help to alleviate constipation (Staudacher, et. al., 2011). Omitting or limiting particular "problem foods", such as high fat foods, spicy foods, lactose containing foods, foods with high sugar content as well as alcohol and caffeine, are commonly recommended. Limiting carbohydrates associated with causing intestinal gas (e.g., oligosaccharides) like beans, barley, Brussels sprouts, cabbage, figs, and soybeans, is advised in order to reduce luminal distention. Ironically, the constant focus on foods to eat and foods to restrict may cause anxiety about eating, which can further contribute to the IBS symptoms and GI

distress. In addition, the patient is encouraged to establish regular scheduled eating patterns, increase physical activity, consume adequate fluids and fiber, and ensure they get adequate rest and relaxation so as to improve symptom control (Escott-Stump, 2012).

However, these tactics, individually or in combination, do not always address the symptoms. A growing body of evidence is demonstrating the effectiveness of a low fermentable oligosaccharide, disaccharide, monosaccharide, and polyols (FODMAP's) diet in treating IBS. These fermentable, short-chain carbohydrates (SCC) represent a primary food source that can contribute to the chronic symptoms of IBS due to the way in which FODMAPs can be malabsorbed or biologically processed. While SCC's can be beneficial to colonic health, they may also present a digestive challenge for some, namely sufferers of IBS. In controlled trials in Australia and the United Kingdom (U.K.), the implementation of a low FODMAP diet resulted in an average 76% improvement in IBS symptoms (Staudacher et al., 2011). These repeatable results demonstrate the effectiveness of a low FODMAP diet in controlling IBS symptoms and, due to the nature of some of the studies, that this diet therapy is more effective than the existing National Institute for Health and Clinical Excellence (NICE) dietary guidelines currently used in these countries. It should be noted that the NICE guidelines are very similar to the current standards in the U.S. Consequently, it would be expected that the treatment of IBS here in the U.S. with the low FODMAP diet would result in superior symptom control compared to the existing standard therapy.

As a result, there is an opportunity to develop a comprehensive resource for U.S. dietitians to use to assist their patients suffering from IBS where metabolic malabsorption is the primary driver of the symptoms. This "tool kit" of resources

will contain the FODMAP dietary strategy and tactics, a FODMAP content table for fruits, vegetables, dairy products and grains as well as patient tools for label reading, dining out and menu planning.

Metabolic Malabsorption Mechanisms

Malabsorption of foods can occur for a number of reasons. Metabolic malabsorption is defined as the incomplete absorption of a nutrient in the small intestine. It is commonly caused by the bacterial fermentation of dietary compounds that "escape" digestion in the small intestine (Gemen, deVries, & Slavin, 2010). Malabsorption requires careful consumption management of the trigger component(s) so that the overall intake of problem foods per meal does not cross a patient's individual threshold and result in symptoms. Food intolerance, on the other hand, usually requires total avoidance of a given compound due to the inability of the body to process a particular component (Scarlata, 2010).

Food Allergy

A food allergy is an abnormal or an exaggerated immunological response to a food antigen, which can be due to a classic type 1 IgE-mediated immediate reaction, a type 4 cell mediated delayed hypersensitivity response or both (Cabre, 2010). The prevalence of food allergies in the general adult population is lower than 4% (Beyer, 2008). About two thirds of patients with IBS believe their symptoms are triggered by specific foods. This causal relationship, however, is difficult to prove (Cabre, 2010). Recently, an in-vitro activation assay of basophils by food allergens (based on levels of CD63 expression) has been reported to identify food hypersensitivity in IBS patients with 86% sensitivity, 88% specificity, and 87% accuracy (Carroccio et al., 2010). Common

food allergies include eggs, peanuts, milk, tree nuts, soy, fish, shellfish, and wheat (National Library of Medicine [NLM.NIH], 2013)

Food Intolerance

Food intolerance is an adverse reaction brought about by nonimmunological factors in the foods, such as toxins (e.g., food poisoning), or pharmacological agents (e.g., caffeine or tyramine), host enzyme deficiency (e.g., lactase deficiency) or idiosyncratic responses induced by an unknown mechanism (Cabre, 2010). A classic example of food intolerance is lactose malabsorption. Lactose intolerance has been reported to occur in about 25% of patients with IBS in the U.S. and northern Europe (Bohmer & Tuynman, 1996), whereas the prevalence may be as high as 52 – 68% in Mediterranean countries (Vernia, Ricciardi, Frandina, Bilotta, & Frieri, 1995). Lactose intolerance can cause osmotic diarrhea and bloating and hence may be more frequent in the subset of IBS patients in whom these symptoms predominate (Bohmer & Tuynman, 1996). Other potential sources of food intolerances include food additives and gluten (National Institute of Allergy and Infectious Diseases [NIAID], 2013).

Slow Transport Mechanisms

Some dietary nutrients have slow, low-capacity transport mechanisms (e.g., fructose, GLUT5, GLUT2) for absorption (Gibson, Newnham, Barrett, Shepherd, & Muir, 2007). Fructose absorption is enhanced by co-ingestion with glucose, since glucose uptake stimulates additional transport pathways for fructose absorption in the small intestine. Because of this, the fructose released from the hydrolysis of sucrose is generally completely absorbed (Barrett & Gibson, 2007). If fructose is present in excess of glucose, then the risk of fructose malabsorption is greater (Gibson & Barrett, 2007).

The prevalence of fructose malabsorption can be as high as 34% - 61% of the population, whether healthy or with GI disorders, (Barrett, Irving, Shepherd, Muir, & Gibson, 2009). Fructose and sorbitol malabsorption occur among IBS patients, their prevalence being particularly high when both sugars are administered together (31 – 92%)(Cabre, 2010).

Lack of Enzymes

Fructans are linear or branched fructose polymers and are the naturally occurring storage carbohydrate for a variety of fruits and vegetables, including onions, garlic, artichokes, bananas, as well as grains. Wheat is a major source of fructans in the diet and contains 1 – 4% fructans in solid matter (Gibson & Shepherd, 2010). Additional sources of fructans are inulin and fructo-oligosaccharides (FOS), which are increasingly being added to foods for their putative prebiotic effects (Biesiekierski et al., 2011). Because the small intestine lacks the hydrolases capable of breaking the fructose - fructose bonds, and fructans can't be transported across the epithelium, they are not absorbed at all (Barrett & Gibson, 2007). Formal examination of this has confirmed that 34- 90% of ingested fructans can be recovered from small intestinal output in subjects with an ileostomy (Gibson, P. & Shepherd, 2010). Lack of enzymes is the same malabsorption issue with galactans and galacto-oligosaccharides (GOS), which are primarily found in legumes (e.g., beans, chickpeas and lentils), cabbage and onions (Muir et al., 2009).

Osmotically Active Molecules

Small and therefore osmotically active molecules exert a laxative effect when given in sufficient dose by increasing the liquidity of the contents of the colon and subsequently affecting gut motility (Gibson et al., 2007). In healthy people this may provide a natural

laxative effect. In IBS sufferers, this action may contribute to diarrhea (Biesiekierski et al., 2011). Such molecules include lactulose and artificial sweeteners (Barrett et al., 2010).

Rapid Fermentation Structure

Foods that provide for rapid fermentation by bacteria also contribute to symptoms experienced by IBS sufferers (Gibson et al., 2007). The chain length of the carbohydrate dictates rapidity of fermentation; oligosaccharides and sugars are very rapidly fermented compared with polysaccharides, such as soluble dietary fiber (Gibson & Shepherd, 2010).

While food is not the cause of IBS, for most IBS sufferers, food seems to directly impact the severity of the patient's symptoms. Consequently, by controlling the food triggers and avoiding their individual malabsorption mechanisms, the patient should be able to control, or at least minimize, their symptoms.

CHAPTER 2

FODMAP Studies

In 1996, a team of microbiologists, Gibson, Willems, Reading and Collins, from the Institute of Food Research in Reading, U.K., shared the results from their research on the "fermentation of non-digestible oligosaccharides by human colonic bacteria". Their study focused on the benefits of oligosaccharides as prebiotics to develop a healthy gut environment in humans. This premise proved to be sound for people with an existing healthy, functioning gut, however, the positive benefits didn't result as expected in individuals with a hypersensitive intestinal tract, such as those suffering from various digestive disorders. In spite of this, their research illuminated the opportunity that those with localized intestinal disorders might also benefit from gut flora manipulation, but in terms of elimination, not supplementation.

Subsequently, the low FODMAP diet was developed by a team of healthcare and research professionals in Australia, Gibson, Muir, Barrett, Shepherd and Parker at Monash University, Department of Medicine. This dietary therapy was devised as a biochemical solution to address the metabolic malabsorption issues experienced by some people with digestive problems. When this population digests various sugars, sugar alcohols, and oligosaccharides, it commonly results in symptoms of gas, bloating, diarrhea and/ or constipation. These SCC's have common functional biological properties in that they are osmotically active (Barrett et al., 2010, Shepherd & Gibson, 2006), are poorly absorbed (Gibson, G., Willems, Reading, & Collins, 1996), and rapidly fermented (Gibson, G., et al., 1996, Ong et al., 2010, Shepherd & Gibson, 2006). The initial diet therapy focused primarily on fructose and fructan malabsorption, due to the

increasing volume of these components in the Western diet and the increasing frequency with which this malabsorption issue was presenting in the patient population. However by 2005, a fully comprehensive low FODMAP diet was developed and undergoing research evaluation with human subjects. The use of a low FODMAP diet as a therapeutic strategy for managing IBS symptoms has proven effective in retrospective studies (Choi, Kraft, Zimmerman, Jackson, & Rao, 2008, Shepard & Gibson, 2006**,**), randomized, controlled studies (Barrett et al., 2010, Shepard et al., 2008, Staudacher et al., 2011,), and a single-blind, crossover invention study (Ong et al., 2010). While all but one of these studies was conducted in Australia, there is a growing body of evidence that suggests this diet therapy could be an effective treatment of IBS symptoms worldwide for those individuals experiencing any metabolic malabsorption.

In 2011, a randomized crossover intervention study by Staudacher et al. in the U.K. demonstrated that a FODMAP restricted diet reduced osmotic load at the terminal ileum. In this study, 82 adult IBS patients were evaluated for symptom presentment (e.g., bloating, gas, diarrhea, and constipation) in conjunction with one of two dietary management strategies they had been placed on. Of these patients, 39 were treated with the standard NICE protocol for handling IBS symptoms and 43 were treated with a low FODMAP diet. The NICE protocol involved regular meal patterns, modifying fiber intake, as well as reducing alcohol and caffeine. Additionally, these subjects were educated to reduce resistant starches and add linseeds and probiotics to reduce overall symptom presentment. In some cases, depending on the patient's symptoms and history, certain specific advice was also provided as appropriate (e.g., for lactose malabsorption, the exclusion of dairy). There were no statistically significant differences between the

two groups with regard to age, gender, or prevalence of each type of symptom prior to starting the dietary intervention. All patients had their diet and symptoms assessed prior to starting their particular course of treatment. After a nine-month period, an evaluation of the two therapeutic courses of action showed a higher proportion of the low FODMAP diet group reporting improvement for each symptom assessed compared to the standard NICE treatment group. There were significantly more patients in the low FODMAP diet group who reported improvement in bloating (low FODMAP 82% versus standard 49%, $P = 0.002$), abdominal pain (low FODMAP 85% versus standard 61%, $P = 0.023$), and flatulence (low FODMAP 87% versus standard 50%, $P = 0.0001$). When all symptoms were combined into a composite symptom score, there was a significant difference between groups, with more patients in the low FODMAP diet group having an improvement in score (low FODMAP 86% versus standard 49%, $P < 0.001$). This difference in degree of improvement was predominantly driven by a strong trend for fewer patients in the low FODMAP diet group reporting deterioration or no change in symptoms (low FODMAP 14% versus standard 51%). In the end, overall satisfaction with their symptom response and dietary therapy was 76% of patients in the low FODMAP group compared to 54% in the standard group ($P = 0.038$). However, it should be noted that no differences were seen between the groups in relation to constipation symptoms.

In a 2010 study by Ong et al., 15 healthy subjects and 15 subjects with IBS were evaluated on symptom presentment based on consumption of a high FODMAP diet (i.e., 50g of FODMAP's) as well as a low FODMAP diet (i.e., 9g of FODMAPs) and the results were compared. The diets were matched per person for total calories, total

macronutrients as well as indigestible long chain carbohydrates, dietary fiber, and resistant starches. Patients ate normally for seven days while maintaining a food diary. They then were subjected to a two-day dietary intervention, either a high FODMAP diet or a low FODMAP diet, and tracked their intake as well as completed a GI symptom questionnaire each evening. The results showed that in patients with IBS, all symptoms (e.g., abdominal discomfort, bloating and wind) were significantly worse with the high FODMAP diet when considered individually or combined. As a composite symptom score, IBS patients scored significantly higher during the high FODMAP diet (median 6: range 2-9) than during the low FODMAP diet (median 2; range 0 – 7; $P = 0.002$). The healthy subjects also experienced a higher composite score on the high FODMAP diet (3; 0 – 5 *vs*. 1; 0-4; $P = 0.014$), but this was primarily driven by an increase in the passage of gas. These observations are consistent with the contention that FODMAPs do not cause IBS, but that the symptoms are triggered by an exaggerated bowel response to luminal distention. Additionally, subjects found that after only 24 – 48 hours, a low FODMAP diet reduced colonic gas production in healthy people as well as patients with IBS compared to a high FODMAP diet.

The efficacy of a low FODMAP diet due to the restriction of fructose and/ or fructans in the diet was convincingly shown in a double-blinded, randomized, quadruple-arm, placebo-controlled re-challenge trial by Shepherd, Parker, Muir and Gibson in 2008. In this study, 25 subjects who had both IBS and fructose malabsorption (FM) maintained a low FODMAP diet, which by definition had a low free fructose and fructan content, for the 22-week trial period. The participants were provided all the appropriate food to eat as well as the four different "challenge" beverages. The challenge beverages were

composed of either fructose, fructans, alone or in combination, or glucose. Patients were randomly challenged with the beverages in increasing dosages taken in conjunction with meals for a maximum test period of two weeks. Low dosage was equivalent to 7g fructans, 14g fructose, and 7g glucose. The medium dosage was 14g fructans, 28g fructose, and 14g glucose and the final large dose was 19 g fructans, 50g fructose, and 20g glucose. Diet adherence and symptom presentment were documented daily by the patient and evaluated weekly by the research team. The results showed that "70% of patients receiving fructose, 77% receiving fructans, and 79% receiving a mixture reported IBS symptoms were not adequately controlled compared with 14% receiving glucose ($P \leq 0.002$)". Other results included patients with IBS whose symptoms improved on the low FODMAP diet had a recurrence of symptoms on a re-challenge trial with fructose, fructans, and the combination of the two, but not with the placebo glucose group. Thus, the fact that the subjects developed symptoms of IBS when challenged with fructose and fructans and that those symptoms worsened when higher dosages were consumed supports the advantage of a low FODMAP diet in the management of IBS symptoms and demonstrates the impact of dietary triggers on symptom presentment.

Shepard and Gibson in 2006 studied the impact of two of the most common FODMAPs in the western diet: fructose and fructans. This research focused on the impact of "free fructose", where the amount of fructose exceeds the amount of glucose within the same food product, and the impact of fructans, which are long chains of fructose with glucose at the end, on the presentment of IBS symptoms. This early study involved 62 IBS patients with known fructose malabsorption (FM). They were counseled by a dietitian for an hour on what foods to avoid, what foods were acceptable, how to

balance favorite “avoidance foods” with a free glucose food so that the coingestion of both would eliminate/ minimize the symptoms as well as limiting the overall fructose “load” in any single meal. Most of the patients followed the dietary advice by self-selecting foods that met their taste and tolerance preferences. The most common strategies implemented were substituting alternative foods for problematic foods or using incremental glucose at mealtime to balance out the excess free fructose. They followed this dietary therapy for a median of 11 months (10 – 40 months) for the adherent population and 16 months (2 – 36 months) for the non-adherent population. Of the 62 patients, it was determined that 48 (77%) were adherent to the dietary advice, 10 were partially adherent and 8 were largely non-adherent. The results showed that those patients who were adherent had a greater reduction in symptoms (e.g., abdominal pain, gas, bloating, diarrhea, constipation) than those who were non-adherent (85% vs. 36%, $P< 0.01$; Fishers exact test). For each individual symptom, the adherent group experienced greater reduction in symptoms that the non-adherent group. Interestingly, the non-adherent group did experience improvement in the abdominal pain and gas even though they were largely non-compliant. Consequently, this study demonstrated the potential impact that fructose and fructan malabsorption can have on triggering IBS symptoms and the positive impact of controlling ingestion of such compounds can have on symptom control.

In 2009, Barrett, Irving, Shepherd, Muir, and Gibson evaluated the levels of fructose and lactose malabsorption in both healthy controls and among subjects with chronic intestinal disorders, such as celiac disease, Crohns disease, ulcerative colitis and functional gastrointestinal disorders. Since both fructose and lactose are FODMAPs, the

research team had all 555 subjects follow a low fiber, low FODMAP diet for the 24-hour period prior to the hydrogen breath tests. The hydrogen breath test measures the amount of hydrogen on a subject's breath after consumption of a measured amount of carbohydrates. Theoretically, the hydrogen level, the primary byproduct of digestion, will manifest as high levels of breath hydrogen as carbohydrates are fermented rather than thoroughly digested. While this test is not a perfect method of measurement, it is a standard measure used in research and clinical practice for testing a person's breath hydrogen production. After a day of being on a low fiber, low FODMAP diet, the subjects were asked to fast from 2200 hour and then present in the morning to give a "fasting breath" sample to establish a baseline level of hydrogen production for each individual subject. Then a test solution of lactulose (15g) was given and repeated breath samples were taken every 15 minutes for up to 3 hours to establish each person's first rise in breath hydrogen and their peak time. Subsequently, within two weeks of the lactulose test, each subject was tested with 35g fructose and 50g lactose on separate days following the same protocol used in the benchmark lactulose test. The results demonstrated that carbohydrate malabsorption, as defined by an early rise in breath hydrogen after lactulose, is a normal, physiological event since all subjects, both healthy controls and those with chronic intestinal disorders, had results. The trial also showed that patients with Crohns disease universally had greater carbohydrate malabsorption than the other diseased states for both fructose and lactose. Not surprisingly, the prevalence of lactose and fructose malabsorption increased with age.

While the quantity of trials evaluating the efficacy of the low FODMAP diet are relatively small, there is a growing body of quality evidence that restriction of dietary

FODMAPs leads to symptomatic improvement of overall gut symptoms, including abdominal pain, bloating, and gas in the majority of patients with IBS (Barrett et al., 2009; Ong et al., 2010; Shepherd et al., 2008; Shepherd & Gibson, 2006; Staudacher et al., 2011). This strategy, however, requires knowledge of the principles and the foods that define a low FODMAP diet. The existing dietary therapy for IBS suffers is only moderately effective since it usually targets only one or two factors that may be contributing to symptoms. However**,** it appears from various scientific studies that the low FODMAP diet, which impacts up to five SCC that are commonly poorly absorbed, would effectively manage IBS symptoms in about 75% of the cases, where metabolic malabsorption is the primary source of the symptoms.

Given this body of information and evidence, the utilization of a low FODMAP diet for treatment of IBS patients would seem to be a beneficial course of therapy to manage chronic symptoms in those cases where metabolic malabsorption is the primary driver. This dietary strategy seems to provide superior relief for IBS sufferers than the existing standard therapy.

CHAPTER 3

The Low FODMAP Diet Strategy

FODMAPs are common in a normal diet, thus providing people suffering from IBS with the knowledge and tools to restrict these dietary components will enable them to minimize or eliminate the chronic symptoms from which they suffer (Gibson & Shepherd, 2010). Therefore, in order to identify which FODMAPs are contributing to a patient's symptoms, it is necessary to create a neutral, functioning gut in which to test the various FODMAP categories. By strategically testing each FODMAP category with the patient for a week, both the dietitian and the patient will be able to assess and evaluate symptom presentment from metabolic malabsorption (Catsos, 2012).

In order to achieve meaningful results, the patient must commit to the dietary principles of the low FODMAP program for an eight-week period of time. The knowledge gained from the program will only be as useful as the precision of the execution. If a patient "cheats" on the low FODMAP diet program, they will be undermining the integrity of the tests and that will render compromised results, ultimately impacting what they have to restrict long term. By the same token, complete adherence to the eight-week program will define what, if any, malabsorption issues exist and which categories are troublesome triggers for them (Catsos, 2012).

During the eight-week program the patient will submit to both an Elimination diet of just low FODMAP foods as well as five Challenge phases, where they will test their gastrointestinal (GI) track with foods from each different FODMAP category to see which one(s) elicit symptom presentment. The initial Elimination diet period will result in establishing a neutral gut, "eliminating" high FODMAP foods from their daily diet by

consuming just low FODMAP foods for the first two weeks. At the beginning of week three, the weekly introduction of foods high in one of the five FODMAP components, such as fructose, fructans, galactans, lactose, or sugar alcohols, will be incorporated into the baseline low FODMAP diet so that symptom presentment can be monitored. The introduction of one of the FODMAP categories is called a "challenge". During the Challenge phases it is important for the patient to be vigilant about introducing just one category of FODMAPs at a time. FODMAPs have an accumulative impact in the gastrointestinal tract, hence patients may be able to tolerate small amounts of a given FODMAP, but can develop symptoms if they consume quantities that surpass their total individual threshold for the accumulative intake of such fermentable carbohydrates (Scarlata, 2012). If the patient partially fills their personal threshold with previously challenged FODMAPs, then they are not giving the current FODMAP a fair, comparable test. A period of three days between challenges, called a "wash out period", where the patient is just on the low FODMAP elimination diet again is required in order to get the GI track back to a neutral state before the introduction of the next FODMAP challenge category (Catsos, 2012).

Once the patient is educated on the program principles and there is discussion about the different challenge phases, it is not uncommon for the patient to have an opinion about which FODMAP's are driving their symptoms. Sometimes these preconceived notions make it difficult for the Registered Dietitian to stage all five challenges because the patient is so certain of some and dismissive of other FODMAP's. While the patient's opinion is probably largely based on experience, it is important that all five different FODMAP's be tested with a neutral GI tract (Catsos, 2012). Since

FODMAPs have a collective effect, the patient's experience may have been impacted by the previous consumption of a malabsorbed FODMAP, which caused the reaction from their suspicious category. Consequently, the food or FODMAP they think is the biggest offender may just be the one that hit their "tipping" point. It could be that they save that "offending" food for the end of a meal, when their personal threshold is already at its limit, hence their association with that food as a problem FODMAP. Perhaps if they ate that food first, it would be some other food that would "tip" their threshold and cause symptom presentment. The FODMAP threshold will be different for each individual so it is important to keep in mind the total FODMAP load (Gibson, G, & Shepherd, 2010). Ensuring participation in all five challenges is an important discussion to have with patients so as to preserve the overall integrity of each challenge and the overall results (Catsos, 2012).

In the end, most patients do not have to eliminate all FODMAP's long term, but which one(s) drive their symptoms is/are very individual. By accurately testing the tolerance of each FODMAP category, the patient will define their personal thresholds and ensure maximum variety in their diet (Gibson, G, & Shepherd, 2010). Throughout the program the patient will have to maintain a food diary and track their symptoms. This record will become a valuable reference for both the Registered Dietitian and the patient over the course of the eight weeks. Additionally, as a Registered Dietitian, you may need to customize the patient's low FODMAP diet alternatives, particularly for those who have special dietary requirements, such as vegan, celiac disease, diabetes, and menopause (Catsos, 2012). Various resources in this tool kit, such as the daily food and

symptom tracking worksheet, sample menu ideas, the nutrient sources for participants on the low FODMAP diet, may assist in that process.

Label reading will also be critical for patients while on this program. Many of the packaged, processed, and canned products patients normally eat may be full of "hidden" FODMAP's that are contributing their symptoms. It will be important for the patient to read all the labels on the foods they own and buy to ensure that the ingredients contained in those products are not any of those listed on the high FODMAP tip sheet. The patient should be counseled to avoid processed or packaged foods where multiple FODMAPs are listed or where a single FODMAP is one of the first five ingredients. "Common hidden sources of FODMAP's include: salad dressings (use vinegar, lemon & olive oil); broths and broth based dishes (soups and risotto), condiments, marinades, sauces, and gravies" (Scarlata, 2012).

Lastly, as with any diet, prior to the patient beginning the low FODMAP diet program it is critical that they be screened by a doctor that such a diet is appropriate for their given symptoms, that they are medically classified as having IBS, and that they are healthy enough to participate on the program. Additionally, the patient should consult with their doctor regarding all the medications and supplements (i.e., fiber supplements, probiotic supplements or vitamin and mineral supplements) they are taking. Since medications and supplements can also be sources of hidden FODMAPs, which could potentially impact the results in a Challenge phase, it is best to discuss the necessity of continuing on these products during the eight-week program. Potentially other alternatives might be appropriate during this test period. Obviously, if existing

supplementation is medically necessary, then it is important for the patient to continue with their intake (Catsos, 2012).

Diet Implementation

The week prior to starting the eight-week program, it will be important for the patient to track their food intake and symptoms (Palmer, 2005). This will become an important reference tool for the patient at the end of the Elimination diet phase and each Challenge phase. As with any food diary, the patient should track what they ate, when they ate and the quantity. The tracking worksheet should include everything that the patient consumes. This means not only the foods but also all condiments, nutritional bars or drinks, candy, gum, medications and supplements as well as just that "one little taste" of something they had for a quick snack. If it goes in their mouth, they should write it down no matter how insignificant they think it may be to their issue. When tracking symptoms, the patient needs to be specific about how their stomach feels (i.e., any bloating, cramping, or abdominal discomfort). The patient will be better able to evaluate their symptoms on the program with their historic symptoms if the patient is very specific about their symptom presentment. They will need to track the frequency of bowel movements, the consistency of bowel movements (i.e., Bristol stool chart), if there was painful elimination or a sense of urgency as well as frequency of passing gas (Catsos, 2012).

It will also be advantageous to educate the patient on the tenets of the low FODMAP diet, since this has shown to improve adherence and results (Barrett & Gibson, 2007). Consequently, the dietitian should discuss with the patient the biochemical basis for the low FODMAP diet and the various potential metabolic malabsorption

mechanisms that may be causing their symptoms. Additionally, general guidelines for choosing foods while in the low FODMAP diet should be reviewed:

- Provide a list of acceptable foods on the low FODMAP diet. Also provide a food list of high FODMAP foods by category for patient to know which foods to avoid.
- Encourage food choices where fructose and glucose are in balance or there is more glucose than fructose. Avoid foods with more free fructose than glucose in them.
- Limit the overall fructose load in each meal – either as fructose or as sucrose.
- Avoid foods that have a substantial load of fructans or galactans in them (e.g., > 0.25g of fruit or vegetable fructans or galactans/ meal or > 0.35g of grain or cereal fructan or galactans/meal)
- Avoid foods and products that have a substantial load of polyols, especially sorbitol, in them (e.g., > 0.5g of polyols/meal or > 0.3g of sorbitol or mannitol individually).
- Educate on label reading for shopping purposes.
- Provide menu planning suggestions and dining out suggestions.
- Provide alternative food choices by category for high FODMAP foods.
- Always keep the total FODMAP load in mind.

Improved adherence and compliance is achieved when these low FODMAP principles are understood by the patient prior to the beginning the program (Gibson & Shepherd, 2010).

Elimination Diet

Once the benchmark tracking of their symptoms on their regular diet has been completed and they have their doctor's clearance that they are healthy enough to be on a diet, they are ready to begin the low FODMAP program. During the first two weeks of the program it will be important for the patient to eat only the foods listed on the low FODMAP handout and just in the quantities listed by category. Most fruits, vegetables, milk products, legumes and grains contain some amount of FODMAPs. Consequently, even a food identified as a low FODMAP food can become a high FODMAP food and cause symptoms if eaten in quantities greater than the defined serving size. Additionally, over eating a low FODMAP food can also cause the patient to reach their personal tipping threshold and thus prevent the development of a neutral gut (Catsos, 2012).

At the end of two weeks, the patient should return for a visit to discuss their experience and symptoms. For most, the Elimination diet will have had a noticeable impact on their development of symptoms and provided them a great sense of relief. It will be useful to review with them their diary of symptoms from before the Elimination phase and have them specifically define the extent of relief from their symptoms. Their perception will be the benchmark of improvement, since in the end it is ultimately their judgment if this diet is effective for them (Catsos, 2012).

While the low FODMAP diet has shown to reduce symptoms in 76% of cases, there is still a population of people for which this diet cannot help (Staudacher et al., 2011). Hence, some will feel they have not had much change in symptoms despite being on the low FODMAP diet for two weeks. It will beneficial to review in detail the symptom differences between the pre Elimination diet and the post Elimination diet to

assess if there are any improvements. It would also be advised that you confirm their understanding and adherence to the Elimination diet before concluding there has been little to no improvement (Gibson & Shepherd, 2010). If in fact the diet was properly followed and there was no improvement in symptoms, then their IBS symptoms are not related to dietary drivers and there is no need to complete the Challenge phase of the diet. For them, the program is over and they need to go back to their clinician for alternative treatment (Catsos, 2012).

For patients that did see improvement on the low FODMAP diet, the Challenge phase is next. In this part of the program, the patient will now "reintroduce" one of the five FODMAP categories into their diet so as to test for symptom development. Since their symptoms should be minimal at this point, the introduction of an offending FODMAP should present itself quickly and clearly (Catsos, 2012).

Challenge Phase

The Challenge phase is approximately a six-week period whereby the patient will test one of the five FODMAP categories each week with a three-day wash out period in between challenges. During the Challenge phase the patient should use the foods listed on the corresponding FODMAP challenge tip sheet and incorporate only those foods into their existing low FODMAP diet. Foods at the top of the list are higher in that particular FODMAP component and are encouraged to be used in the Challenge phase in order to elicit a reaction. Challenge symptoms can take hours to days to present depending on the category and the individual sensitivity to that particular FODMAP (Catsos, 2012).

It is recommended for the first day of a new challenge that the patient only eat a single portion of a FODMAP food from the category being tested in case that particular

FODMAP component is a major driver of symptoms for their system. If the patient has a severe reaction to just that one serving, then the patient should go back on the Elimination diet for a couple days to stabilize before trying another food within that challenge category. If the second food also results in a severe reaction, and there were no other variables that could contribute the extreme reaction (i.e., extreme stress, illness, food poisoning) then the patient has identified one of potentially five FODMAP categories for which they have a malabsorption issue (Catsos, 2012).

In most cases, though, it will take a larger quantity of an offending FODMAP to elicit a reaction. Consequently, on the second day and thereafter, it is advised for the patient to have at least one serving of food from the defined FODMAP category per meal and snack. The higher the food in FODMAP concentration, the more likely a reaction is to occur if the patient has some sort of malabsorption issue with that category. Sometimes a patient might get a reaction to one food within a FODMAP category but not others due to:

- Portion size – the amount of FODMAP varies by food/ product consequently the amount of FODMAPs in one serving will differ based on the food, even within the same category.
- Intestinal sensitivity – a patient might just be more hypersensitive to one type of FODMAP (i.e., a particular fructan or galactan) than another type of FODMAP, which results in a more rapid response.
- Food intolerances - gluten sensitivity or celiac disease or lactose intolerance

- Food allergy (i.e., peanuts, milk, eggs, shell fish, fish, soy, tree nuts, wheat)

When symptoms do present during a Challenge phase, the patient must track their specific symptoms and decide if the symptoms are something they can tolerate. Ultimately the patient will have to chose between dropping the category completely, because of the severity of the reaction, or use the awareness of their sensitivity to portion control how much they intake at one time so as not to "tip" their system (Catsos, 2012). Since symptom presentment usually occurs within the first 3 days of a Challenge period, if a patient is not getting any reaction from a particular FODMAP category within 4 days of increased consumption, they should return back to the Elimination diet for three days, cleanse their system, and start on a new category of FODMAP's not yet tested. Patients should not incorporate any tested FODMAP category – whether they tested negative or positive to it – while completing the Challenge phase. It is important that a neutral GI track and a consistent biological environment be used for the testing of each FODMAP category. Once all the Challenge phases are over, the patient can then include into their diet the FODMAP components for which they had no reaction during the Challenge phases (Catsos, 2012).

At the end of each Challenge phase the Registered Dietitian and patient should discuss the reaction the patient had with the challenged category. While the week is still fresh in their minds, it is important for the patient to ensure their food diary is comprehensive of their intake and that their symptom tracking is clear and specific. Ensuring accurate tracking and results are critical to the end analysis. Reviewing the food diary and symptom log will provide valuable information for assessment of

symptom presentment and the patient's potential threshold for a particular FODMAP category as well as overall threshold. Using current FODMAP food data, the Registered Dietitian can estimate total daily FODMAP intake, of which a subset will be the amount consumed of a particular category. Comparing this data with their symptom log, the Registered Dietitian can then determine if this FODMAP category was a source of malabsorption for the patient. It will also be important to identify if there were any other variables, such as a change in stress levels, a change in physical activity, or change in anxiety during the week that might impact the patient's results.

Finally, at the end of the eight-week program the Registered Dietitian should review with the patient the results of each week and gain alignment on the assessment of malabsorbed FODMAPs to be avoided in order to better manage the patients IBS symptoms. The malabsorbed FODMAP categories should be eliminated from the patients diet with dietary advice on alternative food sources or supplementation in order for the patient to maintain a healthful, nutritious diet even though some foods are being eliminated. For those foods that only marginally affected the patient, it becomes a matter of strategic preference for dealing with those categories. They can eliminate the foods altogether and consume the alternative food options or they can self-monitor their intake so as to not hit their particular threshold which elicits symptoms.

CHAPTER 4

Counseling Considerations

The patients state of health and dietary preferences will ultimately impact the final consult once the patient has completed the eight-week program. Outlined below are several factors to consider ensuring their health and nutrition needs are met. It is critical that the Registered Dietitian consider all the FODMAP nutrients that are an issue for the patient as they choose an alternative food since some of the alternative sources may be high in other FODMAPs. This isn't an issue if that FODMAP isn't a problem for the patient, but won't help them if they consider that alternative a safe choice.

Elimination of Lactose

Dairy products are the primary source of lactose containing foods, but certainly other processed foods contain lactose as well, such as baked goods. They also happen to be the primary source of calcium for most people. Consequently, an individual who is diagnosed as lactose intolerant will have to obtain their calcium, and likely some of their vitamin D, from other sources. Low FODMAP sources for calcium include fortified rice and soy products (soy has galactans, so if they are galactan sensitive too, soy is not an option), such as milk, yogurt and cheeses made from rice or soy. Other rich sources of calcium can be found in spinach, dark green leafy vegetables, sardines, salmon, tofu, almonds, and fortified cereals. The other alternative is to supplement with a calcium and vitamin D daily.

Elimination of Fructose

Fruits as well as beverages and processed foods (e.g., sodas, sauces, dried fruit, fruit juice, jams, jellies, …), which contain high fructose corn syrup (HFCS), are the

primary sources of fructose in the diet. Some vegetables as well as agave and honey also contain high levels of fructose. Fruits are a primary source of various vitamins and minerals and the specific micronutrient is dependent on the particular fruit. Since there are a variety of acceptable fruits and vegetables on the low FODMAP diet that contain multiple vitamins and minerals, there shouldn't be an issue with obtaining adequate levels of micronutrients as long as the patients eats some recommended produce.

Elimination of Fructans

Fructans, inulin and fructo-oligosaccharides (FOS) are found in a variety of foods. Fructans are found naturally in some vegetables and wheat products. Inulin and FOS can be added to some processed foods and beverages to increase the fiber of the product, promote growth of good bacteria, and/ or enhance the product's shelf life. Label reading will be key to avoid fructans. If fructans have to be eliminated, then the patient will have to consider other sources of grains and baked goods to avoid wheat, the primary source of fructans in the U.S. diet. Grains and whole grain breads are a primary source of fiber, iron, niacin, thiamin, riboflavin, folate, vitamin B_6, magnesium, and zinc. Consequently, it will be important for a patient to obtain these important micronutrients from other grain sources such as quinoa, brown rice, spelt bread, corn products, gluten free products, and oatmeal.

Elimination of Galactans

Galactans and galacto-oligosaccharides (GOS) are primarily found in legumes and beans (e.g., kidney beans, baked beans, soy beans, chickpeas, and lentils). They are a primary source of protein for vegetarians as well as niacin, thiamin, vitamin B_6, vitamin B_{12}, iron, magnesium, potassium, and zinc. If the patient is a vegetarian and has to limit

their intake of galactans then the dietitian will have to work closely with the patient to define acceptable options to achieve their protein intake from other sources. Some times that may mean simply defining what the tolerable portion sizes are of galactan containing foods may be so as to help them meet their nutritional requirements and yet not set off any reaction. The other valuable micronutrients can be obtained from acceptable fruit, vegetable, and grain sources.

Elimination of Polyols

Polyols can occur naturally in some fruits and vegetables as well as developed from corn, sugar cane, or whey and are used as additives to various processed products. Label reading will be a primary tool when defining processed foods with polyols in them. Polyols are primarily a sweetener, hence the nutritional value in the foods in which they are added are not high in nutritional value (e.g., sugarless gum, candies, and meal replacement bars). The fruits and vegetables that contain naturally occurring polyols do have many valuable micronutrients, but can easily be substituted for other low FODMAP fruits and vegetables to obtain those vitamins and minerals.

A list of acceptable foods to obtain different vitamins and minerals can be found in the tool box and can be used as a reference with counseling a patient based upon what category of FODMAPs they have to eliminate. The more FODMAP categories to eliminate the more restrictive the dietary options become which is why strict adherence to the Challenge phase of the program is important so as to not be unnecessarily limiting. In most cases, not all FODMAP categories are eliminated in the end.

CHAPTER 5

Conclusion

The low FODMAP diet has proven successful in its clinical studies to date. However, the total number of dietary studies and scope of population has been somewhat limited. Consequently, the opportunity exists for further research on several factors.

First and foremost, further studies are warranted in other regions of the world in order to test the effectiveness of the diet on other ethnicities. To date the diet has been tested largely on a Caucasian population. Expanding the research to other ethnic populations could provide further support of the diet therapy or introduce some valuable insight into some limitations due to the inherent biochemical processing of FODMAPs unique to a certain ethnicity.

In order to further test the effectiveness of this diet in other regions and ethnicities, it is critical that the FODMAP content of the foods in various geographic areas be analyzed to provide the require data. Most of the low FODMAP diet research has been completed in Australia, largely because the diet was developed there. Consequently, most of the FODMAP content data is on various common Australian foods. Given that the raw materials (e.g., flour) and food processing methods (e.g., milling processes) may be quite different in other regions than from what has been tested in Australia, further evaluation of various raw food and processed foods is necessary to further the research and test the diet therapy in other regions of the world.

Biologically, it would also be valuable to know the long-term effects of restricting foods that have a prebiotic affect on the flora in the gut. In particular, both fructans and galactans are commonly added to some processed foods for the healthful benefits these

prebiotics serve in a normal gut. However, due to the biochemical nature of these FODMAPs and the visceral hypersensitivity of most IBS patients, these compounds contribute to the patient's painful symptoms. Understanding the long-term health impact of restricting such nutrients would be valuable to know in order to manage both the risk and compensate for the outcome, if necessary.

Lastly, gaining the approval and endorsement of the American Medical Association for this dietary therapy to effectively treat IBS would be a valuable opportunity. Recognizing that the medical community is primarily concerned with solving the etiology of a particular problem and that this diet does not cure IBS, there is a case that this dietary therapy could be compared to drug therapy to effectively treat the IBS symptoms of diarrhea, constipation, gas and abdominal pain, to help patient's manage their symptoms. In fact, as a dietary treatment, there are no side effects to manage as opposed to a potential drug therapy, which may result in other side effects. To that end, there may be an opportunity for this tool kit to be incorporated into the Academy of Nutrition and Dietetics website of references for registered dietitians to have access to in order to assist their members in providing appropriate guidance in the low FODMAP diet therapy.

However, while there are still knowledge gaps and opportunities for more research, it would seem that monitoring a patient on the low FODMAP diet and leveraging its biochemical principles would be an effective and logical course of action. In doing so, not only the annoying and embarrassing symptoms of gas, bloating, and unexpected bowel changes become more controlled, but there will be an improvement in the quality of life for those who suffer from IBS.

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Appendix

Appendix A - Daily Food and Symptom Tracking Worksheet

Date (M/D/Year)	**Time** (AM/ PM)	**Meal** (B/L/D/S)	**Food/ Beverage Medication/ Supplement**	**Quantity** (ea. ingrdt)	**Symptom** (B/C/D/G/P)	**Duration**	**Severity** (1 - 5)	**BM** (1 - 7)	**End of day Score**

Appendix A - Daily Food and Symptom Tracking Worksheet - Legend

Header	Meaning
Date	Month/ day/ year. (i.e., 5/7/12)
Time	Time of consumption and AM or PM (i.e., 9:00 AM)
Meal	B = Breakfast; L = Lunch; D = Dinner; S = Snack
Food/ Beverage/ Medication/ Supplement	What was consumed. Either as a stand alone food (i.e., apple, calcium supplement, or Zocor) or as a combined food/entrée (i.e., lasagna, grilled cheese sandwich, vegetable soup). In the case of a entrée, break out each ingredient and the approximate volume of each ingredient in the combined food. Be specific with each ingredient so that the FODMAP content can be determined.
Quantity	How much of a food or ingredients did you consume (i.e., 1 apple, 20 grapes, 1/4 of a cantaloupe, 2 slices of bread, 3 oz. of cheese, …)
Symptom	B = bloating; C = constipation; D = diarrhea; G = gas; P = abdominal pain Describe any other symptoms you have in detail so as to capture the feelings of the moment.
Duration	Duration of time the symptoms bothered you/ you felt the symptoms (i.e., 30 mins./ 2 hours all day).
Severity	Severity of symptoms, ranked from 1 - 5. 1 = minimal discomfort; 3 = moderate discomfort; 5 = debilitating discomfort
Bowel movement	Use the *Bristol stool chart* to identify the consistency of stool.
End of day score	At the end of the day, how comfortable do you feel about symptom control that day, 1 -5. 1 = Great day, no/ minimal symptoms. 2 = Some symptoms, but didn't really impact my day, was able to do all I wanted to do. 3 = Moderate symptoms, once or twice a day, may or may not of impacted my plans. 4 = Moderate symptoms, more than twice a day, impacted my plans. 5 = Severe symptoms and pain, completely debilitated.

Appendix B - Sample Menu Ideas

Breakfast:

1 C Cheerio's
8 oz. Rice milk
½ C Blueberries

Scrambled eggs with bell peppers and cheese:
1 egg/ 2 egg whites
¼ tsp. Dijon mustard
¼ C Greens from green onions
¼ C Red and yellow bell pepper
1 oz. hard cheese – cheddar

2 - 4" diameter Buckwheat pancakes
Maple syrup
2 slices of bacon

1C Corn flakes
8 oz. Lactaid milk
½ C Blueberries

⅔ C Oatmeal
½ C Strawberries
¼ C Brown sugar
8 oz. Almond milk

Scrambled eggs with zucchini and cheese:
¼ tsp. Dijon mustard
¼ C Greens from green onions
½ C Zucchini
¼ C. hard cheese – Parmesan
1 Chicken sausage

1 ¼ C Rice Krispy's
½ C Raspberries
8 oz. Rice milk

Lunch:

Spinach salad
1 C Baby spinach
2 slices of bacon, crumbled
1 oz. Feta cheese
½ C Mandarin oranges
½ oz. Almonds (12 almonds)
Vinaigrette dressing

Baked vegetable medley
1½ C Mixed vegetables of zucchini, yellow crookneck squash, shallots, eggplant, red pepper
2 oz. Gouda cheese
½ C Brown rice

Vegetable sandwich
2 slices Odi's gluten free bread
½ small cucumber, peeled, sliced
2 oz. Cheddar cheese

2 leaves Butter lettuce
1 Tomato, sliced into 4 slices

Chicken raspberry salad
1C Butter lettuce
3 oz. Toasted chicken, shredded
½ C Fresh raspberries
2 oz. Pecans
1 oz. Feta cheese

2 C Vegetable beef soup
3 oz. Beef tenderloin, 1½ C mixed vegetables of yellow crookneck squash, carrots, and tomatoes
¼ Slice cantaloupe

1 C Cooked quinoa
1 C Mixed butternut squash
¼ C Parmesan cheese

2 C Chicken and rice soup
Chicken, rice, chicken broth, carrots, celery, shallots, tomatoes
4 Rice crackers
Navel orange

Dinner:

3 oz. Roast chicken
½ C Cauliflower, steamed
½ C Acorn squash

Flank steak w/ stir fry vegetables
3 oz. Flank steak – grilled, sautéed
1 ½ C Mixed vegetables, stir fried in garlic infused oil – thinly sliced yellow/ red peppers, zucchini, carrots
½ C Rice noodles

3 oz. Salmon, baked
½ C Rice – a mix of brown and wild rice
1 C Mixed steamed vegetables – bok choy, celery, carrots, bell peppers

Chicken in a salad
3 oz. Roast or poached chicken
1 C Butter lettuce
¼ C Freens from green onions
1 oz. Feta cheese
¼ C Roasted pecans
½ C Mandarin orange slices

3 oz. Pork chop, baked or grilled
½ C Butternut squash, baked in olive oil
½ C Risotto

3 oz. Black cod marinated in soy sauce and sautéed in garlic infused oil
1 C Stir-fry vegetables (in garlic infused oil) – bok choy, carrots, bamboo shoots, celery and greens of green onions.
½ C Brown rice

Flank steak in a salad
3 oz. Flank steak, grilled or baked
1C Roman lettuce
¼ C Greens from green onions
1 oz. Cheddar cheese
1 oz. Roasted almonds
½ C Tomatoes

Snack: 2 oz. Lactose free cottage cheese
½ C Fresh pineapple

Lactose free cottage cheese
½ C Fresh mandarin oranges

Cheese quesadilla
1 6" Corn tortilla
1 oz. Cheese mix of Monterey jack and cheddar

¼ slice Cantaloupe melon
2 slices Prosciutto

1 oz. Almonds (24 almonds)

8 oz. Plain, lactose free yogurt
½ C Strawberries

2 C Popcorn

1 slice. Glutino's Flax Seed Bread
1 oz. Cheddar cheese
3 slices Tomato, placed on top of bread with cheese

4 – ½" Wedges of red or yellow bell pepper
1 Hard-boiled egg

1 slice Whole Foods honey oat bread
1 Tbsp. Peanut butter

Appendix C - Nutrient Sources for Participants on a Low FODMAP Diet

Vitamin A:

Organ meats, carrots/ carrot juice, pumpkin, spinach, fortified non-wheat cereals, zucchini, butternut, and yellow crook, cantaloupe, sweet red pepper, tomatoes, enriched lactose free milk products.

Vitamin B_1 (thiamine):

Liver, fortified non-wheat cereals, brown rice, nuts, whole egg, quinoa.

Vitamin B_2 (riboflavin):

Lactose free milk, lactose free yogurt, cheddar cheese, egg whites, liver, beef, chicken, fish, fortified non-wheat cereals, quinoa.

Vitamin B_3 (niacin):

Halibut, ham, pork, potatoes with skin, salmon, tuna.

Vitamin B_{12}:

Lamb, fortified non-wheat cereal, tuna, salmon, beef, lactose free yogurt, turkey, lactose free milk, lactose free cottage cheese, pork, chicken, cheddar cheese. Vegans should use a B_{12} supplement.

Folate:

Oatmeal, spinach (cooked), papaya, oranges, quinoa, sunflower seeds.

Vitamin C:

Red bell peppers, yellow bell peppers, kiwi, orange, grapefruit, strawberries. cantaloupe, papaya, tomatoes, pineapple.

Vitamin D:

Halibut, catfish, salmon, sardines, tuna, egg yolk, Swiss cheese, vitamin D fortified lactose free milk, non-wheat cereal product.

Vitamin E:

Fortified non-wheat cereals, sunflower seeds, almonds, sunflower/ safflower/ canola oil, peanut butter, peanuts, corn/ olive oil, spinach (cooked), sardines, herring.

Vitamin K:

Spinach (cooked and raw), endive, Romaine lettuce, tuna, celery, kiwi, blueberries, strawberries.

Calcium:

Cheddar, Swiss, mozzarella cheeses, calcium fortified rice milk, lactose free milk, lactose free yogurt, salmon, sardines, fortified cereals, tofu, feta cheese, parmesan cheese, lactose free cottage cheese, oatmeal, almonds, orange, spinach (cooked).

Iron:

Calms, fortified cereal, oysters, organ meat, fortified cereals, pumpkin seeds/ pepitas, spinach (cooked), white rice, beef, sardines, duck, lamb, almonds, egg, quinoa.

Magnesium:

Pumpkin seeds/pepitas, halibut, quinoa, spinach (cooked), almonds, oat bran (raw), tuna, peanuts, tofu, peanut butter, brown rice, haddock.

Phosphorous:

Sardines, pumpkin seeds/pepitas, sunflower seeds, beef, swordfish, cod, halibut, salmon, tuna, chicken, lactose free cottage cheese, lactose free milk, lactose free yogurt, pork, oysters, oatmeal, crab, shrimp, cheddar cheese, mozzarella, Swiss, provolone, almonds, peanuts, peanut butter, quinoa.

Potassium:

Lactose free yogurt, calms, halibut, tuna, winter squash, cod, spinach, pork, rainbow trout, cantaloupe, honeydew melon, tomatoes.

Zinc:

Lobster, shrimp, oysters, chicken, beef, eggs, peanuts, oatmeal, turkey, quinoa.

Fiber:

Quinoa, almonds, orange, oatmeal, oat bran, rice bran**,** winter squash, strawberries. non-fermentable fiber supplement, if required.

Protein: (for vegetarians)

Lactose free milk, lactose free cottage cheese, quinoa, tofu, brown rice, oatmeal, eggs.

Reference: Beyer (2012), Academy of Nutrition and Dietetics website (2012), Eastern Health Clinical School. Monash University (2012).

Appendix D - Label Reading Tips

Label reading of packaged and canned foods you own and purchase will be an important part of your shopping routine as you participate in the eight-week challenge. You will not be able to eat any of the high FODMAP foods/ ingredients while on the Elimination diet but will actually search out high FODMAP foods/ ingredients while participating on in a Challenge phase. With experience you will come to know brands in you market that meet your dietary requirements and are safe to consume. Both the ingredient listing and the nutrient facts panel will be your key sources for information.

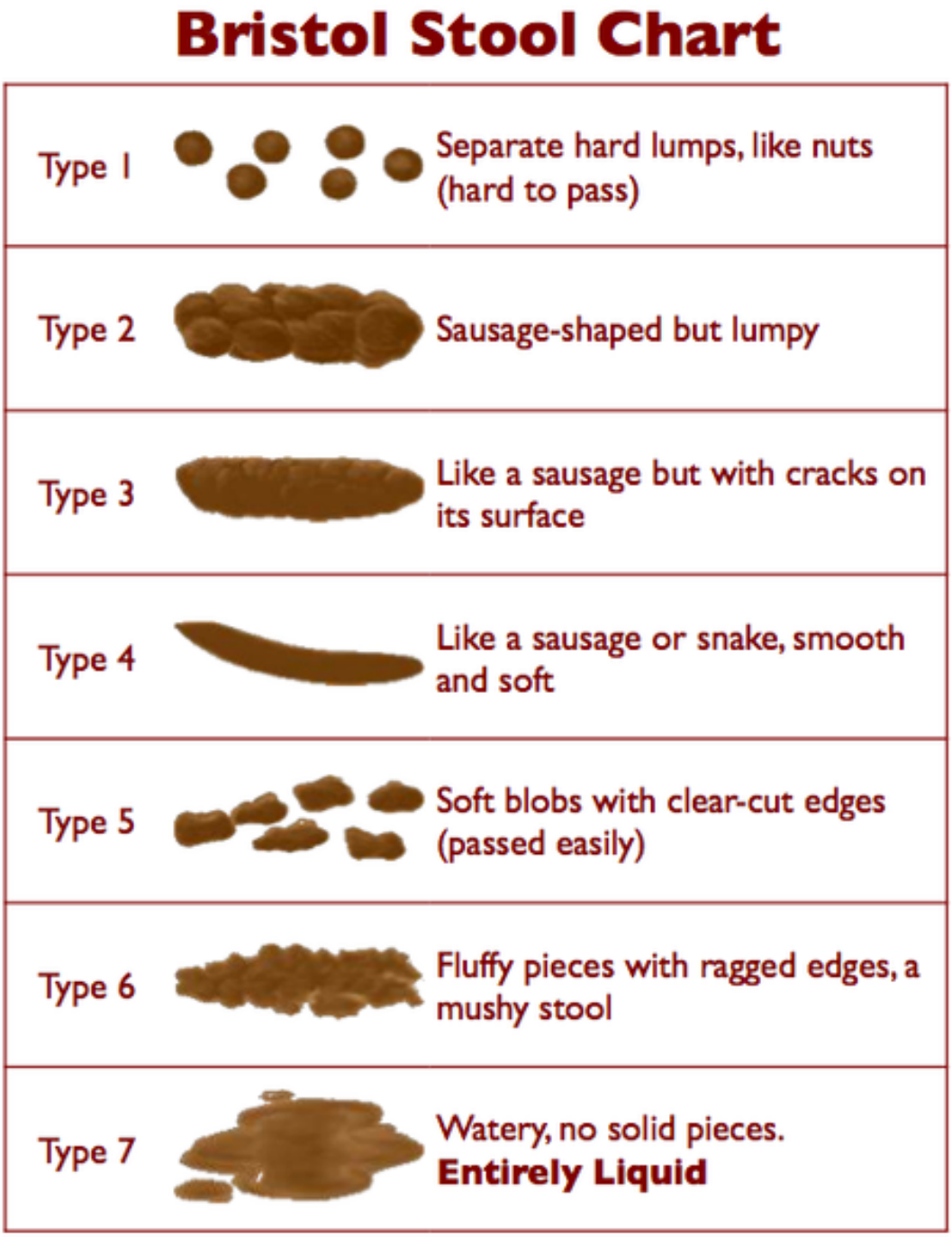
Look at the ingredient list first. Avoid foods that list a high FODMAP ingredient as one of the first five ingredients. Just put it back and walk away. Once you know which FODMAP categories are responsible for your symptoms, then you can restrict only those defined ingredients. The list below is alphabetized, to make it's easier to find an offending ingredient, and color-coded, so that you know by color which ones you need to continue to restrict based upon your final results (e.g., polyols = purple, galactans = green, lactose = **lavender**, fructose = orange, fructans = aqua blue).

agave nectar, agave syrup, barley, brown rice syrup, **butter,** cashews, chick peas, chicory, **condensed milk,** couscous, crystalline fructose, dried fruit, dried fruit wrap/ bar, **dry milk solids, evaporated milk,** fortified wines (e.g., sherry, port), fructose, fructo-oligosaccharides (FOS), fruit juice concentrate, garlic powder or salt, glycerin, glycol, high fructose corn syrup (HFCS), honey, inulin, isomalt, kidney beans, lentils, maltitol, mannitol, **milk powder**, molasses, onions, onion powder or salt, pistachios, polydextrose, red kidney beans, rum, rye flour, starch (unless defined as corn starch), sorbitol, soy beans, soy milk, split peas, tempeh, wheat flour, **whey protein (unless specified lactose free),** xylitol.

If a high FODMAP ingredient is listed or there is an ingredient that you're not sure about and you want to ensure the processed food is safe, you can also check the nutrition facts panel. Lactose and fructose will be represented under carbohydrates as sugars. If the sugar content is more than 3g of fructose or 7g of lactose, then the sugar load in the product is too high for qualifying as a low FODMAP food (e.g., if a cheese has zero grams of sugar in it, then it has no lactose in it and is safe to eat). Fructans and galactans will be represented under the carbohydrate section as dietary fiber on the nutritional facts panel. Since it takes very little of these nutrients to cause metabolic malabsorption, if there is any fiber listed on the panel of the processed food you're unsure about it's safety, then you shouldn't risk the potential that the fiber could be coming from the high FODMAP ingredient on the list

Reference: Scarlatta, 2012.

Appendix E – Bristol Stool Chart



Type 1 has spent the longest time in the colon and type 7 has spent the least. Stools at the lumpy end of the scale are hard to pass and often require a lot of straining. Stools at the loose or liquid end of the spectrum can be too easy to pass - the need to pass them is urgent and accidents can happen. The ideal stools are types 3 and 4, especially type 4, as they are most likely to glide out without any fuss.

Retrieved from http:// www.sthk.nhs.uk/library/documents/stoolchart.pdf.

Appendix F – FODMAP Food List

High FODMAP Foods:

Fruits: serving size - 1/2 cup or one medium piece of fruit.
Apples (i.e, Granny Smith, Jonathan, & Pink Lady), apricots, avocado (< ¼), blackberries, boysenberries, cherries, custard apple, figs, longon, lychee, mango, nectarines, peaches (i.e., clingstone, white, & yellow), pears (i.e., Asian, Anjou, Bosc, Packham & Red Anjou), persimmons, pomegrante (< ¼C seeds), prunes, rambutan, watermelon.
Veg: serving size - 1/2 cup or 1 cup leafy greens
Artichokes (i.e., globe & Jerusalem), asparagus, beetroot, broccoli, Brussels sprouts, cabbage (i.e., common & Savoy), cauliflower, chili pepper, corn, fennel bulb & frons, garlic, green beans, green peas, haricot verts, kale, leek bulb, lettuce (i.e., raddiccio), mushroom (i.e., button), onions (i.e., green, spring, yellow, brown, & white), potato, shallots, snow peas, yellow beans.
Cereal/ grains: serving size = 1/2 cup, 1 slice.
Barley, couscous, rye flour, wheat flour (i.e., all purpose, enriched, white, & whole wheat), wheat and rye based products (i.e., breads, biscuits, cakes, cereals, cookies, crackers & pasta), gnocchi pasta.
Legumes: serving size = 1/2 cup.
Baked beans, borlotti beans, butter beans, chickpeas, kidney beans, lentils (i.e., red & green), lima beans, soy beans, split peas.
Sweeteners:
Agave nectar, agave syrup, brown rice syrup, crystaline fructose, fructose, high fructose corn syrup (HFCS), fruit juice concentrate (i.e., any kind of fruit), honey, isomalt, lactitol, maltitol, mannitol, molasses, sorbitol, xylitol.
Lg dose fructose:
Canned fruit in natural juice, fortified wines (e.g., sherry, port, ...), fruit juice, dried fruits/ dried fruit bars/ dried friut wraps, large servings of fruit or sherbet, rum.
Dairy: serving size - ½ C cottage cheese, 1 oz hard cheeses, 8 oz. lactose free milk, 1 C. lactose free yogurt
Acidophilous milk, buttermilk, cheeses - soft and fresh (e.g., cottage cheese, cream cheese, marscarpone, ricotta); coconut milk, coconut milk ice cream; condensed milk, custard, evaporated milk, gelato, half and half, ice cream; margarine; milk (i.e., from cow, goat, or sheep); milk powder, sour cream, soy milk, yogurt (i.e., from cow, goat, & sheep), whipped cream.
Other:
Cashews, chicory, chicory drins (i.e., Ecco™, Caro™), dry milk solids, fructo-oligosaccharides, garlic or onion powders or salts, glycerin, Hydrogenated starch hydrolysates, inulin, miso, liquid cough remedies, liquid pain relievers, pistachios, polydextrose, sorbet, sherbet, whey protein concentrate (unless lactose free).
Processed Foods:
BBQ sauce, catsup, chutney, jams, jellies, pancake syrup, plum sauce, relish, sweet and sour sauce, tomato paste.

Reference: Biesiekierski, J.R., *et a*l. (2011); Catsos, P. (2012); Eastern Health Cinical School, Monash University (2012); Gibson, P.R. & Shepherd (2010); Muir, J.G., et al. (2009); Muir, J.G., et al. (2007); www.katescarlata.com - FODMAP checklist.

Appendix F – FODMAP Food List

Low FODMAP Foods:

Fruits: serving size - 1/2 cup or one medium piece of fruit. Blueberries, cantaloupe melon, cucumber, dragon fruit, durian, grapefruit, grapes (i.e., red, red globe, seedless, & Thompson), honeydew melon, kiwi, lemon, lime, mandarin orange, navel orange, passion fruit, papaya/ paw paw, pineapple, raspberries, star fruit/ carambois, strawberries, tangelos.
Veg: serving size - 1/2 cup or 1 cup leafy greens Bamboo shoots, bell peppers, bok choy, carrots, cauliflower, celery, chives, curly endive/ frisee, Belgium endive/ French endive/ whitlof, eggplant, green onions/ scallions (green part only), gingerroot, lettuces (e.g., butter, cos/ Roman, iceberg), parsnips, radish, spinach, squash (e.g., butternut, Japanese, pumpkin, scallop/pattypan, yellow crookneck, zucchini), tomatoes, turnip.
Cereal/ grains: serving size = 1/2 cup, 1 slice. Amaranth, buckwheat, corn flour, corn meal, gluten free products (be careful of sugar in these products), kamut, millet, oatmeal, oat bran, oat flour, popcorn, quinoa, risotto, rice (i.e, brown, white, wild), rice noodles, soba noddles, 100% spelt bread/ cereal products.
Legumes: serving size = 1/2 cup. Black eyed peas
Sweeteners: Aspartame (i.e., Equal®, Nutrisweet®), beet sugar, brown sugar, cane juice crystals, cane sugar, cane syrup, confectioners sugar, dehydrated cane sugar, demerara sugar, dextrose, granulated sugar, glucose, high maltose corn syrup, malt extract, maltodextrin maltose, maple syrup, modified food starch, organic sugar, saccharine (i.e., Sweet n' low®), stevia, sucrose, sugar syrup, superfine sugar, sucralose.
Dairy: serving size - ½ C cottage cheese, 1 oz hard cheeses, 8 oz. lactose free milk, 1 C. lactose free yogurt Hard cheeses such as cheddar, colby, edam, gouda, muenster, montery jack, parmesan, provalone, swiss; mozzerella, feta, brie, camembert; Lactose free milk, almond milk, coconut milk; rice milk; lactose free yogurt; butter;
Other: Almonds, almond butter, bakers yeast, baking powder, baking soda/ sodium bicarbonate, carageenan, chocolate, cocoa powder, corn starch, corn syrup (not HFCS), corn syrup solids, guargum, macadamiian nuts, modified food starch, peanuts, peanut butter, pecans, pectin, pine nuts, pumpkin seeds, resistant starch, salt, sesame seeds, soy lecthin, soy sauce, soybean oil, sunflower seeds, vinegar, vital wheat gluten, walnuts, wheat starch, whey protien isolate, xanthan gum.
Protein: Beef, chicken, duck, eggs, lamb, pork, seafood, tofu, turkey.

High Fructans/ FOS: >0.25g fruit or vegetable fructans/meal or 0.35g grain or cereal fructan/meal

Fruits: serving size - 1/2 cup or one medium piece of fruit. Custard apple, nectarines, peaches (i.e. white), persimmon, pomegranate (< ¼C seeds), watermelon. Dried fruit (< 1 Tbsp).
Veg: serving size - 1/2 cup or 1 cup leafy greens Artichokes (i.e., globe & Jerusalem), aparagus, beetroot, broccoli, Brussels sprouts, cabbage (i.e., common & Savoy), corn, fennel bulb, garlic, kale, lettuce (i.e., raddiccio), onions (i.e., brown, green, spring, white, yellow), shallots, green peas, snow peas.
Cereal/ grains: serving size = 1/2 cup, 1 slice. Barley, couscous, gnocchi pasta, rye products (i.e., bread, crackers, …), wheat products (pasta, breads, cakes, cookies).
Legumes: serving size = 1/2 cup Baked beans, chickpeas, kidney beans, lentils (i.e., red & green).
Other ingredients: Cashews, chicory, chicory drinks (i.e., Ecco™, Caro™), fructo-oligosaccarides (FOS), inulin, onion and garlic powders and salts, pistachios

Excess Fructose: >0.2g excess fructose/ meal

Fruits: serving size - 1/2 cup or one medium piece of fruit.
Apples (i.e., Granny Smith, Jonathon, & Pink Lady), boysenberries, cherries, figs, mango, peaches (i.e., clingstone), pears (i.e., Asian, Anjou, Bosc, Packham and Red Anjou), watermelon. Also canned fruit packed in natural juice, any type of fruit juice made from concentrate, and dried fruits/ dried fruit bars/ dried fruit wraps are also prohibited.

Veg: serving size - 1/2 cup or 1 cup leafy greens
Artichokes, asparagus, potatoes, sugar snap peas.

Sweeteners:
Agave nectar, agave syrup, brown rice syrup, crystaline fructose, fructose, high fructose corn syrup (HFCS), fruit juice concentrate (i.e., any kind of fruit), honey.

Other products:
Rum, sherry, port wine,

High Galactans/ GOS: > 0.25g vegetable/ legume galactans/meal or
> 0.35g grain or cereal galactan/meal (raffinos, stachyose)

Vegetables: serving size - 1/2 cup or 1 cup leafy greens
Onion (white), broccoli.

Cereal/ grains: serving size = 1/2 cup, 1 slice.
None by definition of serving. If serving is defined as 2 slices then wheat products (pasta, breads, cakes, cookies), rye bread. (Research quantified only those grain products made in Australia - may not be indicative of products made in U.S.).

Legumes: serving size = 1/2 cup.
Borlotti beans, butter beans, red kidney beans, lentils (green, red, and canned), lima beans, soy beans, split peas.

High Lactose: > 7.0 g of lactose/meal

Milk: serving size - ½ C cottage cheese, 1 oz hard cheeses, 8 oz. lactose free milk, 1 C. lactose free yogurt
Cheeses - soft and fresh (e.g., cottage cheese, cream cheese, marscapone, ricotta); ice cream; cow's or goat milk (reg. and low fat); yogurt (reg. and low fat); buttermilk, whipped cream, sour cream, cream cheese, half and half, butter/ margarine; custard, condensed milk, evaporated milk, powered milk, dry milk soilds, whey protein, kefir.

High Polyols: > 0.5g of total polyols/meal or >0.3g of sorbitol or mannitol individually

Fruits: serving size = 1/2 cup or medium size whole fruit.
Apples (i.e, Granny Smith & Pink Lady), apricot**,** avocado (< ¼ slice), blackberries, cherries, longon (<10), lychee (<5), nectarine, pears (i.e., Asian, Anjou, Bosc, Packham and Red Anjou), peaches (e.g., clingstone, yellow & white), plums, watermelon.

Veg: serving size - 1/2 cup or 1 cup leafy greens
Cauliflower, celery, mushroom (button), snow peas, sweet potato.

Sweeteners:
Isomalt, maltitol, mannitol, sorbitol, xylitol.

Products:
Many processed foods have polyol's added to their recipe. Check the label on all packaged and processed foods for ingredient list.

Appendix G – Dining Out Suggestions for Elimination Diet Phase

Breakfast:
- Cheese or vegetable omelet w/ bacon or sausage
- Scrambled eggs w/ tomatoes and bell peppers
- Steel cut oatmeal, brown sugar, fresh blueberries or strawberries (no dairy unless it's Lactaid milk)
- Cream of rice w/ bacon or sausage

Lunch:
- Salad (butter lettuce, Roman, iceberg, endive, spinach) w/ low FODMAP vegetables (i.e., carrots, tomatoes, celery, radishes, red/ yellow bell peppers), perhaps with added chicken, turkey, ham, flank steak or bacon, along with some cheddar or feta cheese
- Quesadilla from a corn tortilla, with cheddar cheese, red peppers and or chicken added
- Fajitas (chicken, beef or pork) with corn tortillas
- Tacos – chicken, beef or pork
- Enchiladas – check on recipe to make sure no FODMAP's
- Rice bowl with steamed carrots and cauliflower, add chicken or beef

Dinner:
- Roasted/ baked/ grilled chicken or turkey – no breading
- Baked or grilled beef – no breading
- Baked or grilled fish or shrimp – no breading

- Steam vegetables – cauliflower, carrots, spinach, zucchini, or yellow squash
- Side salad of acceptable low FODMAP vegetables, oil and vinegar dressing on the side

- Rice or rice noodles, quinoa, risotto.

- Always ask the waiter how the food is prepared. Beware of hidden sources of FODMAP's such as those found in salad dressings, gravies, soups – both cream and broth, BBQ sauce, tomato paste, sweet and sour sauce, plum sauce, jams, jellies, chutney, catsup, relish, pancake syrup.
- When in doubt, ask for the plainest version of what they are offering without any preparation to it. Control of your intake is essential in the first two weeks of the elimination diet.

Reference: P. Catsos, (2012).

Appendix H – Challenge Diet

Challenge Diet

Important points to remember while participating in the challenge phase of the low FODMAP diet program.

- It is very important to maintain a food diary and track symptoms as you are on the challenge phases. Use the Food and Symptom Tracker form provided by the Registered Dietitian to keep a complete record.
- Symptoms from the introduction of a FODMAP group could occur between hours to days after ingestion, depending on your individual digestive transit time and your individual sensitivity to the FODMAP.
- Read labels on all packaged or processed products to ensure the products you are choosing **DO NOT** contain other FODMAP's in their ingredients. Refer to label reading handout regarding ingredients to avoid by category (Individual Challenge FODMAP handouts).
- Be sure to track EVERYTHING you put in your mouth. That includes condiments, gum, candy, mints, medications and supplements.
- Remember that FODMAPs are accumulative; consequently only eat the foods in the quantities defined.

Data source for the FODMAP content of listed food is from: Biesiekierski, J.R., *et a*l. (2011), Catsos, P. (2012), Gibson, P., & Shepherd (2010), Muir, J.G., *et al.* (2007), Muir, J.G., *et al.* (2009), Scarlata, K., 2012), Eastern Health Clinical School. Monash University. (2012).

Appendix H – Challenge Diet

Fructan Challenge:

During this challenge phase you will be testing your digestive system on its ability to absorb foods that contain fructans. Below is a list of foods that have a high fructan content per serving and therefore should produce some symptoms if an individual has difficulty processing fructans. The foods with the highest concentration of fructans are at the top of the list.

As with every phase, read labels on packaged and processed foods to make sure that the products you choose DO NOT contain other FODMAP's in their ingredients. (i.e., breads might also contain polyols).

Choose one food/ beverage from the list per meal/ snack:

- Protein or snack bar with inulin or chicory root extract.
- High fiber breakfast cereals with wheat, corn, barley, inulin, or chicory root extract.
- Barley.
- Couscous.
- Onions.
- Radicchio.
- Kale.
- Beets/ beetroot.
- Shallots.
- Scallions (white part).
- Garlic
- Pasta made from wheat.
- Rye bread, products.

Appendix H – Challenge Diet

Fructose Challenge:

During this challenge phase you will be testing your digestive system on its ability to absorb foods that contain fructose. Below is a list of foods that have a high fructose content per serving or have excess fructose to glucose and therefore should produce some symptoms if a individual has difficulty processing fructose. The foods with the highest concentration of fructose are at the top of the list.

As with every phase, read labels on canned, packaged and processed foods to make sure that the products you choose DO NOT contain other FODMAP's in their ingredients (i.e., dried fruit with sorbitol or mannitol as a preservative). Additionally, since pears and apples contain multiple FODMAPs, do not eat them during this challenge since it will not define exactly which FODMAP is causing symptoms.

Choose one food/ beverage from the list per meal/ snack:

- Beverages with crystalline fructose (i.e., Emergen-C® Fizzy Drink Mix., Glaceau Vitamin water®).
- Agave syrup or nectar.
- Carbonated soft drinks, ice tea, or punch with HFCS, particularly Coke®, Pepsi®, or Sprite®.
- Barbeque sauce with HFCS.
- Pancake syrup with HFCS.
- Ketchup with HFCS.
- Jam or jelly with HFCS.
- Honey.
- Applesauce, sweet and sour sauce made with HFCS.
- Fruit chutney.
- Fruit juices in servings of 8 oz. or larger (except pear or apple).
- Dried fruits in servings of 3 oz. or larger (except pear or apple)
- Canned fruits in natural juices, such as pineapple, mandarin oranges, or peaches.
- Mango.

Appendix H – Challenge Diet

Galactans/ Galactooligosaccharides (GOS) Challenge:

During this challenge phase you will be testing your digestive system on its ability to absorb foods that contain galactans and GOS. Below is a list of foods that have either a high galactan content or high GOS content per serving and therefore should produce some symptoms if an individual has difficulty processing galactans and/ or GOS. The foods with the highest concentration of these components are at the top of the list.

As with every phase, read labels on packaged and processed foods to make sure that the products you choose DO NOT contain other FODMAP's in their ingredients.

Choose one food/ beverage from the list per meal/ snack:

- Butter beans/ lima beans.
- Chickpeas/ hummus.
- Split peas.
- Tempeh.
- Veggie burgers made from soy.
- Soymilk.
- Coffee – more volume than usual.

Appendix H – Challenge Diet

Lactose Challenge:

During this challenge phase you will be testing your digestive system on its ability to absorb foods that contain lactose. Below is a list of foods that have a high lactose content per serving and therefore should produce some symptoms if an individual is unable to process lactose. The foods with the highest concentration of lactose are at the top of the list.

It is important that during this phase you DO NOT choose lactose free products as you had been doing during the elimination phase. Do not take lactase tablets or make any other modifications to your diet to make it easier/possible for you to process lactose. The purpose of this phase is to determine how well your body processes lactose unaided.

As with every challenge phase, read labels to make sure that the products you choose DO NOT contain other FODMAP's in their ingredients (i.e., yogurt with added HFCS or honey).

Choose one food/ beverage from the list per meal/ snack:

- Evaporated milk.
- Fluid cow's milk (whole, low fat or nonfat).
- Goat's milk.
- Milkshake, vanilla or strawberry.
- Frozen yogurt, ice milk, soft serve ice cream, vanilla or strawberry.
- Yogurt, plain or sweetened with sugar only.
- Greek yogurt, plain or sweetened with sugar only.
- Full fat ice cream, sweetened with sugar only, vanilla or strawberry.
- Cottage cheese (whole, low-fat, non-fat).
- Kefir, plain or sweetened with sugar only.

If a patient has a reaction even to lactose free milk products, then their issue is likely not lactose but perhaps casein sensitivity, which will not be addressed through this FODMAP diet.

Appendix H – Challenge Diet

Polyols Challenge:

During this challenge phase, you will be testing your digestive system on its ability to absorb foods that contain sugar alcohols or polyols. Below is a list of foods that have a high polyols content per serving and therefore should produce some symptoms if an individual has difficulty processing these components. The foods with the highest concentration of polyols are at the top of the list.

As with every phase, read labels on packaged and processed foods to make sure that the products you choose DO NOT contain other FODMAP's in their ingredients.
(i.e., dried fruits, such as apricots, pineapple, dates, might also contain HFCS).

Choose one food/ beverage from the list per meal/ snack:

- "Sugar free" candy or cough drops that contains sorbitol, isomalt, xylitol, maltitol, mannitol, lactitol, polydextrose or hydrogenated starch hydrolases.
- Prunes.
- Blackberries.
- Mushrooms, any kind.
- Cauliflower.
- Pumpkin.
- Gum that contains sorbitol, isomalt, xylitol, maltitol, mannitol, lactitol, polydextrose or hydrogenated starch hydrolases.
- Apricots.
- Avocado.
- Plums.
- Celery.
- Fennel leaves.
- Sweet corn – any form.
- Figs, fresh.