Roughage can be Smooth: Could Fiber Fortification be the Answer the U.S. is Looking For?

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Obesity is reaching epidemic proportions in the U.S. as one in eight Americans is now classified as obese (National Health and Nutrition Examination Survey, qtd. in Malinauskas). Consequently, other diseases rates, such as cancer, diabetes, hypertension and high cholesterol, are also climbing. Additionally, cardiovascular disease (CVD) has now become the number one killer of Americans (Ludwig, et al. 1539). Together obesity and CVD related expenses cost our government over $275 billion each year (Mozaffarian, et al. 1; Obesity Costs 1). These facts are frustrating because these diseases are all partially preventable as they are all closely related to one's diet. More specifically, the risks for these conditions can increase or decrease by the absence or presence, respectively, of dietary fiber.

The American Dietetic Association (ADA) recommends that Americans consume 20-35 grams of fiber each day; however the typical American takes in only 14-15 grams per day (1-2). Americans' busy lifestyles, the increase in meals eaten away from home and the popularity of low-fat and/or high protein diets all contribute to low fiber intakes (Rimm and Laidman 1). Furthermore, the majority of the population does not take in the recommended amounts of fruits and vegetables, some of the major sources of fiber (Fernandez 35). Complicating this matter is the fact that most Americans do not fully understand the need for fiber in one's diet as fiber is usually only associated with keeping one "regular." Moreover, the ADA notes that a large number of individuals who are fiber deficient describe their fiber consumption as "about right" (2). Due to the dismal health state of our nation and the obvious knowledge gap held by the public in relation to fiber, I contend that food manufacturers should be required to adjust

certain food ingredients in order to incorporate small amounts of functional, or added, fibers (fibers that are not naturally found in a food source) into commonly consumed products, such as snack crackers and cookies, with the aim of assisting in the prevention of life-threatening diseases. This paper will examine the health benefits and consequences of dietary fiber in disease prevention and maintenance as well as the history and success of disease eradication through food fortification and the steps needed to make fiber fortification a success.

Dietary fiber refers to the components of plant cell walls that the human body cannot break down. Therefore, fiber is not absorbed, but rather passes through the small intestine into the colon where it is fermented and degraded by bacteria (Erkkila and Lichtenstien 3). There are two types of dietary fiber, soluble and insoluble, distinguished by their differing abilities to dissolve in water. Soluble fibers include gums, mucilage and pectin and are found in whole grains, citrus fruits, apples, oatmeal and legumes. Insoluble fibers include cellulose, hemi-cellulose and lignin and are found in carrots, peas, and root vegetables. The different types of fibers have distinctive physiological roles in the body. Soluble fibers absorb water in the gut, helping to create gels that slow stomach emptying and reduce the absorption of fats, cholesterol and glucose. With the reduction of absorption of these nutrients, the body is forced to use stored fats and glucose and must pull cholesterol from the blood to meet the cholesterol requirements of various body systems. With these characteristics, soluble fiber aids in the prevention of hypertension, high cholesterol, and glucose intolerance, which are all contributing factors to CVD. Soluble fibers also contribute to satiety, making one feel fuller faster, thereby helping to control food intake and weight. Insoluble fibers help increase the growth of beneficial bacteria in the gastrointestinal tract, aiding in the detoxification of contents and inhibiting the growth of tumor cells. Increased bacterial growth also contributes to fecal bulk, which causes increased

frequency of defecation and decreased gut transit time. These qualities allow insoluble fiber to prevent the development of colon cancer, constipation and other colon ailments. Besides these natural fibers, there exists a category of "added" or "functional" fibers, which are nondigestible carbohydrates that have been isolated from fiber sources and are used for their physiological roles in the body (Gallagher).

Obesity, defined as having a body mass index (BMI) greater than 30 kilograms/square meter, greatly increases one's risk for myriad other health conditions. BMI is a universal measure used to assess an individual's level of body fat. Much research has been conducted on the relationship between obesity and fiber intake. Krombout, Bloemberg, Seidell, Nissinen, and Menotti studied fiber intake and energy expenditure in seven countries around the world. Their results suggest that fiber intake has a statistically significant inverse relationship with BMI and skinfold thickness, a second indicator of body fat. Interestingly, fat intake did not demonstrate a relationship with body fat levels. The researchers concluded that fiber intake is a larger component in the determination of body fat that dietary fat intake (303). A second study corroborated these results, finding that fiber intake is negatively associated with body weight and that total and saturated fat intake has no relationship to one's weight (Ludwig, et al. 1539).

Today, more Americans are dying from CVD than from any other health condition (Ludwig, et al 1539). Similar to obesity, researchers are interested in the correlation between fiber intake and CVD risk factors, which include: high total cholesterol, high low density lipoprotein (LDL) cholesterol, low high density lipoprotein cholesterol (HDL) and hypertension. It is well known that soluble fiber decreases total cholesterol levels by sequestering bile acids, the building blocks of cholesterol, in the intestines (Gallagher). Errkila and Lichenstein additionally report that each three gram increment of soluble fiber, from sources

such as oats and psyllium, can lower total cholesterol by approximately 0.15 mmol/L (4). Likewise, Fernandez claims that increased, adequate fiber consumption can lower LDL cholesterol, or the "bad" cholesterol, by 7-12% (36-37). Fiber supplementation has also been found to normalize blood pressure in hypertensive patients (Streppel, et al. 154). Insulin resistance and glucose intolerance, other major risk factors of CVD and markers for diabetes mellitus type II, can also be stabilized with a diet high in fiber (Erkkila and Lichenstein 4-5). Finally, researchers at Harvard found that the risks for a heart attack decrease by 19% just by incorporating ten additional grams of fiber into one's diet each day (Rimm and Laidman 1).

Cancer is another disease high on the list of causes of mortality. Colorectal cancer has become the number one killing cancer in the U.S., but its origin and development still puzzles researchers. However, evidence suggests that environmental factors, mainly diet, play a large role in the development. Since indigestible substances in food, such as fruit, vegetable and cereal fibers, are eliminated through the colon and rectum, it is probable to suggest that these substances, to different degrees, have a role in the etiology of this cancer (Terry, et al. 525). It is proposed that fiber's main action in the colon is to decrease fecal transit time, thereby limiting the amount of time toxic materials are in contact with the intestinal lining. Fiber also participates in binding bile acids-some of the break down products of lipid digestion that can be carcinogenic-and eliminating them from the body. Additionally, fiber may initiate a chain of reactions that results in a lower pH in the colon, thereby creating an undesirable environment for cancer growth. Again, fiber has been found to decrease the level of circulating insulin in the body. This is significant in relation to cancer because a chronic increase of insulin in the body has been thought to activate cancer cells and initiate their proliferation (La Vecchia 178-179).

Medical scientists have been struggling for years trying to find reliable cures for these common, deadly diseases. The elusive 'cure' could someday be found right in a hometown supermarket. This is because throughout recent history, many widespread diseases have been virtually eliminated through the use of food fortification and enrichment technology. Food fortification is the process of introducing novel nutrients into a food source that naturally does not contain those specific nutrients in order to increase the nutritional value of that food source. This term, fortification, is often confused with the term enrichment. Enrichment actually refers to the process of returning nutrients that are lost during processing. The U.S. has a successful record with fortification and enrichment as the rates of many once common ailments have drastically declined after specific nutrients were added or returned to commonly consumed items. The first fortification occurred in the 1920's when the government mandated that iodine was to be added to salt to help decrease the rate of goiter. Initially there was opposition towards this action, but the public began to accept the fortification after a successful public education campaign, which took place before and during the introduction of the iodized salt. Next, in the 1930's vitamin D was added to milk to subdue the rising number of children developing rickets, a debilitating bone disease. Unlike iodine and salt, the government never required dairy producers to fortify their products with vitamin D. The majority of producers began voluntarily fortifying as the public's knowledge about the benefits of vitamin D increased and consumer demand for fortified milk rose. The 1940's saw the mandated enrichment and fortification of flours and breads with iron and various B vitamins including: thiamin to prevent beriberi, niacin to prevent pellagra and folate to prevent birth defects. As with previous fortification steps, public education operations played a large role in consumer awareness, acceptance and demand for fortified flours and breads. The most recent, large scale fortification occurred in the 1980's when calcium was added to many products after a government statement claimed that calcium is

an essential element in the prevention and management of osteoporosis. These various fortification steps have resulted in contemporary consumers that are more nutritionally aware than ever, which has subsequently led to an increase in demand for healthy food products (Bishai and Nalubola 37-46). Besides lowering disease rates, benefits of food fortification include: cost-effectiveness, quick implementation, sustainability and, most importantly, no required change in an individual or public dietary habits (Hoang and Gottlieb 1).

The current condition of increased public nutritional awareness is the perfect environment in which to introduce a government mandated fortification program for fiber. Max Kamien, honorary research fellow at the University of Western Australia and contributor to the Medical Journal of Australia, explains that it is wise to initiate a food fortification program if there is an obvious health problem in the general population, if the nutrient to be introduced will not produce adverse effects and if the food to be fortified is widely available so that all in the target population receive adequate amounts of the nutrient (638). The U.S. Food and Drug Administration, the government organization that would most likely implement this new program, also has guidelines for fortification of foods. These rules include fortifying sources at levels that would allow average daily intake to from all fortified sources to stay below the recommended tolerable upper intake levels. These levels should also be safe for all demographic groups so not to cause negative health effects in any portion of the population (1).

One possible fiber product that could be used in this proposed program is psyllium. Psyllium is a plant composed of tiny seeds covered by husks. Food manufacturers use these husks, which are full of soluble fiber, to create gels that impart textural qualities to foods. The soluble fiber in psyllium is concentrated, with approximately 70 grams of fiber in every 100 grams of psyllium (Farnworth 1). Emerging evidence suggests that psyllium is a

wonder food. First, psyllium supplementation has been showed to decrease LDL cholesterol by 7% (Fernandez 37). As a soluble fiber, psyllium also has been found to relieve constipation and diarrhea, to aid in the management of irritable bowl syndrome, diabetes and hypertension and to decrease the risks for cardiovascular disease, obesity and colon cancer. These health benefits are seen with a psyllium intake of about ½ teaspoon/day. Although possibly unknowingly, the public has already been introduced to psyllium as it is a component of many commercial fiber supplements and laxatives (University of Maryland Medical Center 2-3). In order to incorporate psyllium into the food supply, it could be ground up into a fine powder for easy addition to the ingredient list of many commonly consumed products, such as white breads, crackers, pasta and other foods that may or may not have had natural fiber before processing procedures stripped the fiber away.

Although fiber has countless beneficial characteristics, too much fiber can produce undesirable consequences in the body. Just as fiber binds fat and cholesterol, it can also bind essential proteins, vitamins and minerals, which leads to a decrease in the absorption of these compounds. Besides binding nutrients, fiber also can bind medications, thereby lowering their concentrations in the blood (University of Maryland Medical Center 3-4). Gas, or flatulence, is another well know side effect of fiber. A less known negative effect of increased fiber consumption is diarrhea (American Dietetic Association 998). A different downside of synthetic fibers, specifically, is that evidence points toward phytochemicals and antioxidants innate to fibrous foods as playing large roles in the protective benefits of observed from high fiber diets (Terry, et al. 531). Therefore, foods with added functional fibers would not carry the same level of protective benefits as consuming whole grains, fruits and vegetables. These sub-optimal fiber

and fiber supplement characteristics should be taken into account when formulating the fiber content of possible sources for fortification.

In order to for this proposal to succeed, a few specific activities must occur. As with past fortification efforts, a public education campaign would be necessary to help encourage acceptance of fiber fortified foods. The government may also consider creating incentives for food manufacturers, such as allowing them to place health claims, such as "lowers cholesterol," on their products. Hopefully, increased public awareness will accomplish two things: cause an increase in consumption of fruits, vegetables and whole grains and cause an increased demand for fiber-fortified products, giving manufactures more motivation to include fiber supplements in their products.

Optimally, Americans should consume more whole grains, fruits and vegetables in order to prevent or manage various detrimental health conditions. However, old habits are difficult to change, so until Americans take in the recommended amounts of these foods, the government needs to take steps now to protect the future of millions of its citizens. By mandating fiber fortification, the government may also decrease, by millions, the amount of money spent on CVD, cancer and obesity related health care costs. Previous authorized food fortification programs have been very successful at eradicating once common diseases and have greatly improved the quality of life and life span of Americans. Fiber fortification holds the same potential. Fiber fortification will help reduce the rates of many common, potentially deadly ailments and will aid in stabilizing the current and future health status of our country.

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