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REVIEW STUDY ON CARBOHYDRATES AND FIBRE

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ABSTRACT

The diets high in fibre such as cereals, nuts, fruits and vegetables have a beneficial impact on health because their intake has been linked to reduced incidence of many illnesses. The diets with high concentration of fibre have been found to have a beneficial impact on health. During processing the foods undergo different physical, chemical, enzymatic and thermal treatments, which directly or in directly influence the composition of total fiber in the past, carbohydrates have been regarded of merely as a source of energy and fibre. However, recent research has revealed a myriad of photoactive chemicals contained within fibre fractions of carbohydrates, as well as a wide range of beneficial physiological functions (such as increased transit time, production of short chain fatty acids, increased satiety etc.) which can be ascribed to various substances found in carbohydrates. This study highlights the function of carbs in health and looks at the various kinds of carbohydrates, current dietary consumption, and the effect of fibre on prevention of cancer, heart disease and weight gain. In addition, the study examines the prebiotic activity of resistant starches.

KEYWORDS: *Carbohydrates, Cereals, Fibre, Cancer, Digestive Disorders, Prebiotics.*

1. INTRODUCTION

Although carbs have long been recognized as the most significant source of energy in the human diet, more recent research has emphasized the significance of carbohydrates (especially various kinds of fibre) in the maintenance of health and prevention of illness. In addition to their nutritional and physiological activities, carbohydrates also perform a broad variety of physicochemical tasks in meals, contributing to appearance, texture, colour and taste. Recognizing the contribution that carbohydrate-rich foods such as cereals and cereal products contribute to the typical diet, this article examines the function of dietary carbs, fibre and prebiotics in the maintenance of health. It also highlights current research on the links between these elements and optimum health and illness prevention[1]–[5].

1.1.Classification Of Dietary Carbohydrates:

Carbohydrates are produced by plants from sunlight, carbon dioxide and water during photosynthesis. The main products are sugars, which give energy, and may be polymerized into both starches and non-starch polysaccharides in order to offer a method of storing energy, as well as fulfilling structural roles for plants. In the human diet, carbohydrates supply a significant percentage of energy intakes, ranging from as low as 40 percent total energy in western nations to as high as 80 percent total energy in underdeveloped regions. Carbohydrates have historically been regarded of merely as an energy source, but are increasingly acknowledged as essential dietary

components which have a broad variety of health impacts. Such physiological consequences are highly reliant upon the pace and amount of digestion/absorption in the small intestine, and fermentation in the large intestine.

Dietary carbohydrates include primarily starches and sugars, as well as non-starch polysaccharides (NSP), the latter being the primary component of dietary fibre (see Table 1). (see Table 1). Sugars (predominantly monosaccharide's and disaccharides) and starches (polysaccharides) are broken down in the small intestine to glucose and provide energy for the human body (3.75 kcal (16kj)/g). NSP and certain starches (called resistant starches) are not digested in this manner, but may undergo fermentation in the large intestine to produce short chain fatty acids which can be used as a source of energy[6], [7].

Starches are primarily present in cereal grains and potatoes which offer additional nutrients such as B-vitamins, minerals, protein and fibre. Sugars, however, are present in meals such as fruits, vegetables and milk which offer antioxidants, vitamin C, b-carotene, calcium and soluble fibre. However, once sugars are taken from crops (e.g. sugar cane or sugar beet) and condensed into their pure form primarily as sucrose, they offer energy alone and no additional nutrients. Sucrose is added to a broad variety of produced meals and beverages, creating a range of products with varied nutritional benefits. To attempt to differentiate between the contributions that various sugar-containing foods contribute to the diet.

The UK NSP (or dietary fibre) comprises insoluble celluloses found primarily in cereals and grains, particularly whole grain, and soluble pectin's and gums, which may be found in most fruits, certain cereals (e.g. oats and barley) and legumes (e.g. dried peas, beans and lentils) (e.g. dried peas, beans and lentils). Vegetable fibre includes equal quantities of insoluble and soluble fibre (Department of Health 1994) and has no direct metabolic role, but it is an essential component of the diet owing to its positive effect on gut health. This will be examined in greater depth later in this essay[8]–[11].

1.2.Carbohydrate Dietary Requirements:

The Dietary Reference Values (DRV) for carbohydrate may be represented as a percentage of total energy consumption (Department of Health 1991). (Department of Health 1991). It is suggested that the proportion of total carbohydrate to the diet (excluding any contribution from alcohol) should be about 50 percent energy, with NMES consumption not exceeding 11 percent energy. These percentages have been set at levels designed to decrease the prevalence of heart disease, obesity and dental cavities. The DRV for fibre is 18 g/day.

1.2.1. Intakes Of Dietary Carbohydrate:

The National Diet and Nutrition Survey of Adults aged 19–64 years is one of several national surveys carried out in the UK on behalf of the UK Food Standards Agency and the UK Department of Health, with the aim of gathering information about the dietary habits and nutritional status of the British population. The most current study, which was carried out between July 2000 and June 2001, showed that carbohydrate consumption was near to the DRV of 50 percent of dietary energy, and was comparable for both men and women. The average daily consumption of carbohydrate was 275 g for males and 203 g for women and constituted 47.7 and 48.5 percent of dietary energy, respectively. However, the research revealed that intakes of NMES were greater, but those of intrinsic sugars and starches were lower than recommended levels. The main contributions to carbohydrate consumption in the adult diet were cereals and cereal products which alone supplied 45 percent of energy intake.

1.2.2. Breakfast Cereals And Health:

Breakfast has been long recognized for its essential contribution to the nutritional intake of both

adults and children, and yet in the UK the typical adult misses 114 breakfasts per year. Eating breakfast increases performance in memory tests for adults, which may have consequences for success at work. Improved mood, feelings of serenity and improved energy levels has also been linked to breakfast eating. Children who eat breakfast tend to make less errors in memory tests, perform better physically and are more creative than when breakfast is missed. Overweight children are more prone to skip breakfast than normal weight children, and may thus lose out on vitamins and minerals provided by breakfast cereals.

Teenagers and adults who eat breakfast cereals frequently drink more milk than non-breakfast eaters, thus attaining a higher calcium status. Breakfast cereals are an excellent source of complex carbohydrates which contain starch, NSP and resistant starch; many breakfast cereals are also fortified with a variety of vitamins and minerals. For example, certain morning cereals are fortified with B-vitamins, iron and occasionally calcium, providing substantial contribution to the dietary intake of these micronutrients.

Data from the National Diet and Nutrition Surveys carried out from July 2000 to June 2001 show the significant contribution of morning cereals to the average diet. Average consumption is little less than one bowl per day and yet this delivers 26 percent of children's iron intake (greater than that supplied by meat, bread or vegetables), as well as 22 percent vitamin D, 20 percent thiamin, riboflavin and folate and 16 percent niacin. Among adults, consumption of breakfast cereals is again slightly under one bowl each day, and accounts for 20 percent iron, 15 percent riboflavin, folate and vitamin B6, 14 percent thiamin, 13 percent vitamin D, and 12 percent niacin intakes each day Fibre.

Based on the Englyst approach, the typical UK diet includes 14 g fibre/day, with some diets being as low as 5 g fibre/day, therefore falling significantly below the recommended daily intake of 18 g fibre/day (Henderson et al. 2003). (Henderson et al. 2003). Many illnesses and disorders are linked to insufficient intakes of fibre, including colon cancer, high blood cholesterol, diabetes, constipation and obesity. It is now clear that it is not simply fibre itself, but its myriad of different effects on the body (for example reducing the post-prandial rise in blood glucose and increasing the speed at which food passes through the intestinal tract) that play such an important role in our everyday health and wellbeing. Furthermore, fibre is a rich source of phytochemicals such as plant oestrogens and antioxidants that may assist to decrease risk of coronary heart disease and certain malignancies. Whole grains have been proven to be excellent sources of dietary fibre, as well as resistant starch, vitamins, minerals, phytoestrogens, antioxidants and other essential nutrients.

1.2.3. Dietary Fibre, Satiety And Weight Control:

Fat is the most energy-dense component in the diet, with protein and carbohydrate contributing less than half the amount of calories per gram. The most concentrated sources of dietary energy are thus those having a high percentage of fat, such as spreading fats and oils, fatty meats, cheese, cream etc. Diets with a high energy density enhance the odds that daily energy needs will be surpassed, resulting in over-consumption and obesity. The least concentrated sources of energy, on the other hand, are meals with high amounts of water and fibre and very little fat such as fruits, vegetables and whole grain or high-fibre cereals.

Therefore, individuals who are overweight may receive equivalent benefit by decreasing the overall calorie density of foods ingested rather than reducing the amount of food eaten. High-fibre meals are proven to enhance satiety as well as decrease food consumption. Conversely, for individuals with weak appetite or with high energy requirements (e.g. the elderly or those receiving cancer treatments), increasing the energy density of the diet and decreasing the consumption of foods with a low energy density may be suitable.

1.3.Fibre, Cholesterol And Cardiovascular Disease:

Consumption of dietary fibre has been shown to decrease the risk of coronary heart disease (CHD) in many studies. Various reasons have been proposed to explain this result including improvement of blood lipid profiles and insulin sensitivity, and decrease in blood clotting and blood pressure. The majority of these associations originate from epidemiological studies, although few of these studies have established the actual size of the reported CHD reduction, compared the effects of different types of fibre (e.g. cereal, fruit or vegetable) or looked at the gender differences in reduction of CHD risk following fibre consumption.

A meta-analysis of studies looking at the relationship between fibre and cardiovascular disease found that those with higher fibre intakes (top 20 percent of intakes) had a 27 percent lower risk of cardiovascular disease, compared with lower intakes (lowest 20 percent of intakes); this further reinforces the invaluable role that fibre plays in disease prevention.

1.4.Fibre And Cancer Prevention:

The connection between food consumption and cancer risk is widely established. For example, the World Cancer Research Fund predicts that 66–75 percent of instances of colorectal cancer might be prevented if guidelines for a better diet and lifestyle were followed. Many epidemiological studies have revealed clear connections between consumption of dietary fibre and malignancies of the colon, rectum, breast and pancreas (World Cancer Research Fund 1997). (World Cancer Research Fund 1997). Moreover, dietary fibres increase stool weight and decrease intestinal transit time. This relieves constipation, dilutes the contents of the colon and minimizes exposure time of the gut to any harmful components that may be present.

Many factors, such as the degree to which fibre is fermented in the colon, as well as its viscosity and binding capability, influence physiological reactions to the intake of various fibres. The various activities of both soluble fibres (which are able to bind bile acids and delay the absorption of carbohydrates) and insoluble fibres (which assist stool bulking and retention of moisture in the colon) help to explain the multiple physiological effects of fibre in cancer prevention. At the same time, however, the variety of fibres makes it difficult to assess the effect of various fibres in mixed diets.

1.5.Colorectal Cancer:

Colon cancer is the third most frequent cancer in males (18 500 new cases/year in the UK) and the second most common in women (16 000 new cases/year in the UK; Cancer Research UK 2005). Dietary fibre is one of the most significant variables believed to prevent colorectal cancer, with well-established molecular processes supporting this notion. High intakes of insoluble fibre, such as wheat bran, increase stool weight, decreasing its transit time through the colon. This reduces the degree of constipation, dilutes the colon’s contents, and lessens exposure time to any harmful components that may be present. Production of SCFA by the gut flora from fermentable, soluble fibres also lowers gut pH and prevents transformation of cells on the colon surface into malignant cells.

1.6.Breast Cancer:

Breast cancer is the most prevalent disease among women in western nations, with over 41000 new cases being identified in the UK each year (Cancer Research UK 2005); however, incidence rate varies significantly across countries. Several dietary variables may be linked with breast cancer. In particular, fat consumption may raise breast cancer risk, whereas plant foods, which contain dietary fibre, vitamins (e.g. vitamins C, E, folic acid and b-carotene) and different phytochemicals (e.g. flavonoids and phytoestrogens) are believed to decrease risk of breast cancer.

Epidemiological studies have emphasized an inverse connection between dietary fat and fibre in

terms of breast cancer risk (i.e. a high-fat, low-fibre diet seems to increase risk, whereas a low-fat, high-fibre diet tends to reduce risk) (i.e. a high-fat, low-fibre diet appears to increase risk, while a low-fat, high-fibre diet appears to decrease risk). Furthermore, worldwide studies have revealed an inverse connection between breast cancer mortality rates and intake of fibre-rich foods (Prentice 2000). (Prentice 2000). A prospective Swedish study of 342 breast cancer cases found a 40 percent lower risk of post-menopausal breast cancer among women with high-fibre intakes (average intake 26 g/day in the top 20 percent of intakes) compared to lower intakes (average intake 12 g/day in the lowest 20 percent of intake). However, this risk decrease was also reliant on fat consumption, with a high-fibre/ low-fat diet resulting in the lowest level of breast cancer risk. While more study is required to properly assess the fibre and fat connection with breast cancer, it seems that a low-fat, high-fibre diet is the best option for a decreased risk.

1.7.Prebiotics, Fibre And Health:

The large intestine is home to a vast and active bacterial colony, and is believed to be made up of approximately 300–500 distinct kinds of bacteria. Gut bacteria may be classified as being either helpful or detrimental (pathogenic) to their host and the balance between the two bacterial type's varies continuously. The primary function of gut bacteria is to ferment undigested food remnants reaching the lower gut, as well as to help in the absorption of any nutrients not taken higher up in the gut. However, there are additional advantages linked with ownership of a healthy and varied gut flora. These include strengthening the immune system, increasing digestion and absorption, production of B-group vitamins and vitamin K, preventing the development of both pathogenic bacteria and malignant cells in the gut wall, reduction of blood cholesterol levels, and decreasing bloating and gas distension.

2. DISCUSSION

The health advantages of having adequate dietary fibre in the diet have been extensively documented and have formed the foundation of dietary recommendations throughout the globe. However, dietary fibre is a complicated nutritional entity, comprised of numerous non-digestible components of food. Debate around the definition and measurement of dietary fibre has led in variations in labeling, description and recommendations given throughout the globe. In the UK, dietary recommendations are established using the percentage of non-digestible material classified as non-starch polysaccharide that is assessed using the Englyst technique. However, the Association of Official Analytical Chemists (AOAC) techniques, employed extensively by the food industry, capture a considerably wider spectrum of non-digestible material, that some believe should be included in any definition of dietary fibre. An effort to reconcile such disparities, perhaps by adopting an approach that considers the health consequences of fractions not recorded in the Englyst technique, is definitely overdue. Additionally, it is apparent that the effects of these different non-digestible components of dietary fibre are not interchangeable, and it is essential that fibre comes from a variety of sources to guarantee optimum health benefits from the fibre in the diet. Traditional 'insoluble' fibres are needed to provide bulk as well as quickly fermentable, viscous fibres to bring about cholesterol reduction. There is also a compelling case for adding slowly fermented components, such as resistant starches, that are well tolerated in the digestive tract and may bring about improvements in gut function.

3. CONCLUSION

Cereal foods are significant providers of nutrients and phytoprotective components; intakes of such substances are insufficient in several nations in Europe, including the UK. While intakes of total carbohydrate are near to recommended limits, the balance between various carbohydrate types in the diet is biased towards sweets (with many coming from sweetened soft drinks) and away from complex carbs. Encouraging the population to increase intake of complex carbohydrates, in particular high fibre and whole grain meals, is a positive health message that has

major public health consequences. Cereal foods are the main sources of complex carbohydrates in the UK diet, with morning cereals having a key part in total nutrition. One of the easiest methods to boost both fibre and carbohydrate intake is to promote regular eating of breakfast, and particularly breakfast cereals. The physiological benefits of carbs, fibre and whole grains, and their role in promoting health are, as yet, only partly known. Many research are ongoing worldwide to discover the molecular processes underlying the reported health advantages of carbs.

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