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Dietary Fiber and Health

Michigan State University

Cooperative Extension Service

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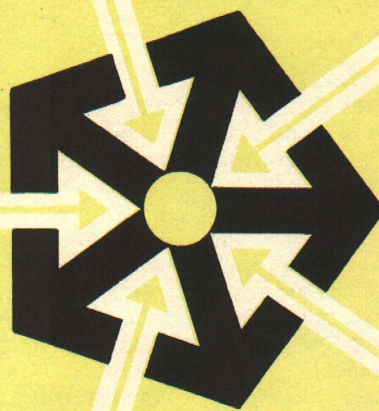
November 1980

2 pages

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NUTRITION VIEWPOINT



MICHIGAN
STATE
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Cooperative
Extension Service
Bulletin E-901

On the Everchanging Field of Human Nutrition

Dietary Fiber and Health

Number 3.
in a series

By Gilbert A. Leveille*

THE NUTRITIONAL QUALITIES of foods are usually described in terms of protein, carbohydrate, fat, vitamin and mineral content. Dietary fiber, or roughage in foods is less frequently mentioned nutritionally, although the value of certain foods high in fibrous materials is known to be desirable for maintaining normal laxation (bowel regularity).

Current interest in dietary fiber¹ stems from the observations of British scientists that specific types of diseases occur less frequently in developing countries in Africa than in Western countries. These scientists suggest that something in the environment which differs between underdeveloped and industrialized cultures must be responsible for the difference in the incidence of various diseases. Their research led them to conclude that the difference could probably be related to decreased consumption of dietary fiber in Western countries in contrast to very high intakes of fiber in developing countries.

NOTE: *This correlation does not necessarily prove cause and effect.*

WHAT IS DIETARY FIBER?

Fiber in diets comes primarily from cereals, fruits and vegetables. There has been a marked reduction in U.S. consumption of these types of foods. U.S. consumption of cereal grains and potatoes has decreased by over 50% during the past 70 years. At the same

¹Dietary fiber includes combined, undigested carbohydrates in food, including cellulose and lignin in crude fiber as well as hemicellulose, pectic substances, gums and other carbohydrates which are not normally digested by human beings.

time there has been an increase in the proportion of our total calories from animal products which contain no fiber.

DIETARY FIBER AND DISEASE

Diseases which may be related to low consumption of dietary fiber include diverticular disease, cancer of the colon, atherosclerosis associated with hypercholesteremia (high levels of cholesterol in the blood), appendicitis, hiatal hernia, irritable bowel syndrome and hemorrhoids. These diseases are relatively rare in developing countries where the diet supplies much greater quantities of fiber than in Western countries.

Let's look at three theories that support the relationship of low fiber intake to the increased incidence of (1) diverticular disease, (2) atherosclerosis and (3) cancer of the colon.

Diverticular Disease

This disease involves an "outpouching" or "ballooning" of the intestinal wall. The pouches (diverticula) do not present a problem unless they become inflamed causing the condition known as diverticulitis. Until recently, a low-residue diet—virtually devoid of dietary fiber—was the standard diet for this disease. British scientists have now shown that diets high in dietary fiber are a more

effective treatment. Their observations, supported by other researchers, are logical in that diverticular disease apparently develops as a consequence of a relatively small, hard, dry residue in the intestine which slows movement through the intestine and increases pressure within the colon. Dietary fiber prevents increased pressure by absorbing large amounts of water, resulting in softer stool, which moves faster. As a consequence, the length of time required for food to pass through the digestive tract is decreased, and the time that the material is in the intestine is reduced. Thus, there is less chance for "outpouching" or "ballooning" to occur.

Hypercholesteremia

Cholesterol is a normal constituent of blood and is found in every animal cell, including humans. It is essential in the manufacture of certain hormones and has other important functions as well. For reasons not fully understood, however, in certain individuals cholesterol and other lipids (fats) can deposit in blood vessels. This can contribute to the development of atherosclerosis.

It is generally believed that higher levels of blood cholesterol in developed countries result from high intake of fats, particularly animal fats. As we increase animal products, including fat, in our diets, we decrease the intake of foods which are high in dietary fiber, namely cereals, fruits and vegetables.

Several studies in both animals and humans have shown that components of dietary fiber can reduce cholesterol levels in the blood. The addition of pectin to the diet is an example. Pec-

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tin, which is not normally digested in humans, has the ability to "bind" bile acids and hasten their excretion from the body. Bile acids are normally secreted into the intestine where they emulsify fats (lipids) from the diet so that these can be digested and absorbed. Then the bile acids are reabsorbed into the body's supply of these substances. The "binding" of the bile acids by dietary fiber (pectin, in the example) and their excretion from the body along with the fibrous material would decrease the amount reabsorbed and thus reduce the supply of bile acid, in the body. This reduction, in turn, would induce an increased conversion of cholesterol to bile acids and thus lower the levels of cholesterol in the blood.

NOTE: *The above explanation, using pectin as an example, is an hypothesis which remains to be proven; it does not necessarily prove that diets containing greater amounts of dietary fiber would, in fact, reduce the incidence of heart disease.*

Cancer of the Colon

This disease has been related to a low intake of dietary fiber. As with the other diseases discussed above, available research shows a low incidence of cancer of the colon in countries consuming greater quantities of dietary fiber. The increased incidence of the disease over the past century in developed countries can be correlated with lowered consumption of dietary fiber or higher consumption of animal products. For example, a very low incidence of colonic cancer has been observed among Japanese residing in Japan, whereas Japanese residing in Hawaii have a higher incidence; and in males, the incidence is virtually identical to that of white males in the U.S.

NOTE: *This correlation, while impressive, does not prove cause and effect. Further research is needed.*

The development of cancer is dependent upon the presence of a carcinogen (cancer-inducing agent) at some minimum concentration inter-

acting with cell tissue. We do not know what carcinogen is responsible for colonic cancer. Intestinal micro-organisms may convert some components of the diet to carcinogenic materials. Ammonia and some bile acids have been suggested as possible carcinogenic agents. It is not known whether the carcinogenic agent is ammonia, resulting from the action of micro-organisms on residual protein, or whether it is a bile acid converted to a carcinogenic material.

A current working hypothesis (which scientists are testing) is that certain micro-organisms in the colon working on some dietary residue produce a substance which is carcinogenic, *if* it is present at a high enough concentration, and *if* it resides in the colon for an adequate period of time.

A diet high in fiber may alter the composition of these micro-organisms and eliminate or inhibit the production of carcinogens.

On the other hand, a diet high in fiber may not contain the material which the micro-organisms would convert to a carcinogenic substance. There is also the possibility that, by decreasing the time the food residues pass through the intestine, dietary fiber reduces the time that tissue can be exposed to cancer-inducing substances.

And, finally, dietary fiber may function to reduce the concentration of potential carcinogens by increasing the water content in the colon.

SUMMARY

I have attempted to point out the current state of knowledge with regard to the effects of dietary fiber on human health. It must be kept in mind that, certainly in the case of the possible relationship between dietary fiber and heart disease and to cancer of the colon, we do not have hard evidence available to demonstrate that increasing the consumption of dietary fiber would be beneficial. We hope to see definite evidence forthcoming.

For the moment, we are faced with the question of whether, on the basis of available evidence, it is desirable to

increase our consumption of dietary fiber. This is not a simple question. It might be helpful at this point to consider another nutritional problem—obesity. Here a reduction in caloric intake would seem desirable by reducing our consumption of animal products and increasing our intake of cereal products. The net effect would be to reduce our fat consumption and to increase our consumption of carbohydrate and of dietary fiber.

Such a change would have no known harmful effect and conceivably could have a beneficial effect. It should be pointed out that dietary fiber has the ability to bind other nutrients in the intestine—that it is known that some indigestible components, namely phytic acid, found in cereals, can bind certain trace elements, such as zinc, and in experimental animals, produce a deficiency of these trace elements.

The decision regarding a dietary change must be an individual one.

It is possible to get enough fiber in regular foods by including some foods from a variety of plant sources every day. This agrees with the advice often given by nutritionists: "For good nutrition, select your diet from a wide variety of foods." As a general rule, unrefined foods contain more roughage than refined foods because some fiber is usually removed in processing. For example, breads and breakfast cereals made from whole wheat contain more fiber than products made from wheat from which the bran has been removed. Raw apples or other fruits contain some roughage, primarily in the skins, which is not present in processed products. Fruits with seeds, such as strawberries, raspberries and figs, are high in fiber. Raw and cooked vegetables are excellent sources of fiber.

The available evidence is not adequate to warrant a general change in the diet of the total U.S. population. There is a need for further research. And the public must be informed regarding the possible desirable as well as the harmful effects of the changes which are occurring in our diet.

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Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8, and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Gordon E. Guyer, Director, Cooperative Extension Service, Michigan State University, E. Lansing, MI 48824.

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