THE EFFECT OF DIETARY FIBER ON LIPIDS
ABSORPTION AND UTILIZATION

THESIS

Presented to the Graduate Council of the
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Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

By

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The purpose of this study was to determine the effect of various types and amounts of dietary fiber on lipid absorption and utilization.

The effect of dietary oat bran, pectin and cellulose at the level of 7.5 per cent and 10 per cent on the fecal fat excretion and on the body weight gain was studied in rats.

The conclusions of this study were (1) that various fibers do not exert similar systemic effects, (2) that food consumption was not significantly altered by inclusion of oat bran, pectin or cellulose, (3) that animals fed diets containing 10 per cent pectin gained significantly less weight and excreted significantly more fat in their feces, and (4) that fecal weight was greatest in pectin and cellulose supplemented animals as compared to controls.
TABLE OF CONTENTS

LIST OF TABLES ........................................ iv

Chapter

I. INTRODUCTION ..................................... 1
   Background of the Problem
   Statement of the Problem
   Purpose of the Study
   Hypotheses
   Significance of the Study
   Limitations
   Assumptions
   Definition of Terms

II. REVIEW OF LITERATURE ......................... 8
   Introduction
   Sources of Fiber
   Properties of Fiber
   Fat, Cholesterol, and Heart Disease
   Lipid Metabolism and Dietary Fiber

III. PROCEDURE OF METHODOLOGY .................. 22
   Population and Sample Selection
   Methods and Sources of Data
   Treatment of Data

IV. RESULTS AND DISCUSSION ..................... 25
   Results
   Discussion

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS . . . 32
   Summary
   Conclusions
   Recommendations

BIBLIOGRAPHY ........................................ 36
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Dietary Fiber</td>
<td>9</td>
</tr>
<tr>
<td>II. Composition of Basal Diets</td>
<td>23</td>
</tr>
<tr>
<td>III. Food Intake and Weight Gain in Rats Fed Various Fibers</td>
<td>25</td>
</tr>
<tr>
<td>IV. Weight of Wet and Dry Feces in Rats Fed Various Fibers</td>
<td>26</td>
</tr>
<tr>
<td>V. Fecal Fat Excretion in Rats Fed Various Fibers</td>
<td>27</td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

Background of the Problem

Within recent years, dietary fiber has been thrust into the forefront of nutritional interest. This interest has been aroused by the several epidemiological observations which indicate that a deficiency of fiber in the diets may play an important role in certain diseases such as diabetes, diverticular disease of the colon, appendicitis, cancer of the colon, obesity, and coronary heart disease (1, 2, 10). Of particular interest is that diets high in fiber are associated with relatively low serum cholesterol levels, increased fecal lipid excretion and lowered incidence of coronary heart disease (3, 5, 6, 8, 11).

Dietary fiber includes cellulose, hemicellulose, lignin, gums, and pectin. When dietary fiber intakes are increased, fecal fat, nitrogen, energy, and mineral excretion increase. These changes suggest that dietary fiber may be altering normal digestive and absorptive function. A number of experiments on animals have indicated that certain foods high in dietary fiber influence blood lipid levels and steroid excretion (1, 4, 7). Although dietary fibers are generally considered as a group, they do not exert similar systemic effects (4, 7, 9).
Statement of the Problem

The problem of this study was to determine the effectiveness of various types and levels of dietary fiber on fecal lipid excretion.

Subproblems of this study were:
1. to analyze the effect of dietary fiber on water absorption and excretion,
2. to analyze the effect of dietary fiber on body weight control, and
3. to analyze the effect of dietary fiber on fecal weight.

Purpose of the Study

The purpose of this study was to examine the effect of various types and amounts of dietary fiber on lipid absorption and utilization.

Hypotheses

To carry out the purpose of the study the following hypotheses were tested.

1. There will be a significant difference in gain of body weight when various types and amounts of dietary fiber are fed to rats.
2. There will be a significant difference in total wet feces excretion when various types and amounts of dietary fiber are fed to rats.
3. There will be a significant difference in total dry feces excretion when various types and amounts of dietary fiber are fed to rats.

4. There will be a significant difference in fecal lipid excretion when various types and amounts of dietary fiber are fed to rats.

Significance of the Study

This study was significant in that it provided further information in regard to the effectiveness of various types and amounts of dietary fibers on lipid excretion, absorption and utilization.

Limitations

The following limitations might arise during the study:

A. Digestibility of the fiber supplements may vary with each animal which can influence the result of lipid excretion

B. Some errors might arise with the experimental equipment which could not be controlled, such as

1. Feeding equipment errors
   a. Food might be lost from feeding equipment and possibly mix with feces

2. Weighing errors
   a. Errors arising from sensitivity of the analytical balance
   b. Errors arising from weights themselves
3. Extraction apparatus errors
   a. Fat might not be extracted completely from sample feces
   b. Some fat soluble materials which are not components of crude fat might also be extracted.

Assumptions

It was assumed that the digestive systems of the test animals had similar potential and function. It was further assumed that all factors which influence the result of this study had the same effect on each studied group.

Definition of Terms

1. Crude fiber--the residue remaining after sequential extraction with ether, dilute acid, and dilute alkali.

2. Dietary fiber--the plant polysaccharides and lignin that are resistant to hydrolysis by the digestive enzymes of man. In addition to lignin and cellulose, dietary fiber also includes hemicellulose, gums, pectin, and other carbohydrates not normally digested by man.

3. Hydrophilic nature--tendency of tissues to attract and hold water.

4. Mucilaginous--resembling mucilage; slimy; sticky.

5. Mucilage--thick, viscid, adhesive liquid, containing gum or mucilaginous principles dissolved in water, usually employed to hold insoluble substances in suspension in aqueous liquids or as a demulcent.
6. **Brush border**—a brushlike structure found on the free surface of epithelial cells.

7. **Hypercholesterolemia**—excessive amount of cholesterol in the blood.

8. **Hypcholesteremia**—decreased blood cholesterol.

9. **Intestinal flora**—the bacteria present in the intestines.
CHAPTER BIBLIOGRAPHY


CHAPTER II

REVIEW OF LITERATURE

Introduction

Current interest regarding the role of dietary fiber stems largely from the observation of Burkitt and Trowell (1, 26), who observed that the incidence of specific types of disease was lower in developing countries in Africa as compared to Western countries. They have concluded that the difference can probably be related to the decreased consumption of dietary fiber in Western countries as contrasted to the very high intakes of fiber in developing countries. Other differences include higher fat intake and increased utilization of animal products in technologically developed countries. Disease that may be related to a low consumption of dietary fiber includes diverticular disease, cancer of the colon, atherosclerosis, obesity, etc.

Although dietary fibers are generally considered as a group, they do not exert similar systemic effects (25, 30, 31). Biological properties possessed by one type of fiber might not be shared by another type. Dietary fiber was defined by Trowell (27) as the plant polysaccharides and lignin that are resistant to hydrolysis by the digestive enzymes of man. Current analytic methods have determined
that dietary fiber is composed of at least six general components listed in Table I (22).

**TABLE I**

**DIETARY FIBER**

<table>
<thead>
<tr>
<th>Type</th>
<th>Plant Cell Function</th>
<th>Special Physical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulose</td>
<td>Cell wall structure</td>
<td>Hydrophylic</td>
</tr>
<tr>
<td>Hemicellulose</td>
<td>Wall stability</td>
<td>Ion binding</td>
</tr>
<tr>
<td>Pectins</td>
<td>Wall stability</td>
<td>Gel-forming ability; Ion binding</td>
</tr>
<tr>
<td>Algal poly-saccharides</td>
<td>Algal cell wall structure</td>
<td>Gel-forming ability</td>
</tr>
<tr>
<td>Lignin</td>
<td>Cell wall strength</td>
<td>Bile salt binding ability</td>
</tr>
</tbody>
</table>

The total quantity of dietary fiber varies markedly in different food (20). Furthermore, each type of food fiber is composed of different proportions of the six basic components listed in Table I. The properties of fiber most important for human intestinal function are a hydrophilic nature, gel-forming ability and a binding capacity for ions or salts.

**Sources of Fiber**

The major sources of fiber among ordinary foods are cereals, vegetables, fruits and nuts. The dietary fiber
content of cereals depends greatly on the degree to which the cereal has been refined. Wheat flour at the extraction rate used in the making of white bread contains about three to four per cent dietary fiber. As the extraction rate is increased, the total dietary fiber increases to the levels found in whole grain of between eleven and fourteen per cent (21).

Vegetables that are eaten with high water contents effectively dilute the dietary fiber so that with the exception of legumes the values for total dietary fiber in fresh vegetables are often less than five per cent. The total dietary fiber in fruits is appreciably lower on a fresh weight basis, less than three per cent (20).

Properties of Fiber

The properties of fiber that are of nutritional significance include bulk density, hydration capacity, binding properties, and fermentability. Plant fiber through its bulk effect promotes faster transit or rate of passage. Animal studies show that fine grinding of the fiber increases the feed density and alters passage and the character of gastrointestinal fermentations.

Feces consists of unabsorbed vegetable fiber, sloughed-off intestinal mucosa, bacteria, water, organic and inorganic substances. The unabsorbed vegetable fiber in feces holds water, some of which is absorbed to the surface of the fiber
(water of hydration); the remainder is trapped in the interstices of the fiber (bulk water). The capacity to hold water is influenced by the chemistry of both the fiber and the liquid phase. The increase in stool weight through water-holding capacity will sweep other intestinal contents; for example, bile acids and electrolytes are excreted in amounts which are directly related to the stool weight (7).

Bile acids are absorbed onto fiber surfaces in fecal material (24). In the upper small intestine conjugated bile acids are involved in micellar formation with lipids with no resultant absorption onto fiber, but in the colon, free bile acids are strongly absorbed. This means that bacterial transformation of bile acids changes the physical state of the bile acids in the intestinal contents by forming derivatives which are strongly absorbed onto the residue (5, 16). Studies of the distribution of bile salts in the rat small intestine indicate that the greatest amount is found in the third quarter which is the area of the small intestine where bile salts are reabsorbed (2). The addition of various polysaccharides, sodium carboxymethylcellulose, cellulose and bran to the diet materially increases the amount of intestinal bile salts (6).

The relationship between dietary fiber and bacteria is complex. Bacteria hydrolyse water-soluble, conjugated organic acids and the less water-soluble fraction produced, e.g. bilirubin, x thyroxine and bile acids will be either
precipitated, absorbed to fiber through hydrophobic bonding or absorbed by the bacteria (5).

Fat, Cholesterol, and Heart Disease

Arteriosclerosis is a general term for the degeneration of the arteries, resulting in thickening and hardening of the arterial wall. Atherosclerosis, one type of arteriosclerosis, is characterized by accumulation of lipids in the walls of medium and large arteries.

Atherosclerosis interferes with the circulation, chiefly to the heart, kidneys and brain. These organs need blood to function efficiently, and when impairment occurs, the effect is noted throughout the system. Atherosclerosis of the coronary arteries—coronary heart disease (CHD)—underlies most heart attacks (8, 11).

In 1972 it was estimated that heart and artery diseases caused over one million deaths, making these diseases the number one cause of death in the United States. Virtually all Americans are to some degree affected with atherosclerosis, and twenty-seven million suffer from hypertension. With men over 35 years old, the incidence of CHD rises to thirty-five per cent of all deaths including over one million cases of heart attack occurring per year. In 1976 more than 1.25 million Americans suffered heart attacks, and of these twenty to thirty per cent died suddenly before they received any medical care. In addition to human
suffering, these diseases cost the nation an estimated $45 billion in lost wages and benefits (8, 14).

The atherosclerotic formations, or atherosclerotic plaques, are made up of fatty materials that are composed chiefly of cholesterol. An artery should have a smooth interior in order to function effectively. Arteries in children are relatively smooth. Over the years, the arteries become less efficient--fatty deposits of atherosclerosis develop; vessel walls thicken; arterial blood is forced to flow through a roughened, narrowed channel. When the blood flow to any particular part of the body is impaired, that portion of the body--for example, the kidneys, the legs, the brain, or even the heart muscle itself--is affected. How much body damage that occurs depends upon the portion of the body involved and upon the severity of the damage to the artery.

Cholesterol has been identified as a major risk factor in the likelihood of developing cardiovascular disease. This substance is a normal component of the cells. It is both produced by the body and derived from the diet. The major catabolic pathway and excretory route of both cholesterol and bile acids is via the feces.

Investigators have made comparisons of the diets of many population groups. Apparently, heart disease becomes more prevalent as the fat content of the subjects' diet
increases. In studies of national origin, it has been found that Japanese people living in Japan had very low incidence of heart attacks. Japanese people who immigrated to Hawaii had a higher rate of heart attacks than those who remained in Japan. Those who immigrated to the United States mainland had an even higher rate of heart attacks. Second- and third-generation Japanese in the United States have heart attack rates approaching that of the native white population. The diets of the Japanese studies contained only 10 per cent fat in Japan, about 30 per cent in Hawaii, and 40 per cent in the continental United States (10).

The amount of fat in the diet tends to rise with increasing affluence. People who are economically poor, either as a national group or as a sub-group within a nation, generally have a diet that is lower not only in total calories, but also in the amount of fat and in the percentage of fat. As economic conditions improve, the diet becomes increasingly rich in total calories and in its fat content. Concurrently, the blood cholesterol level rises, and heart disease becomes more prominent. Consistently, in worldwide observations, persons with high cholesterol levels have been found the most likely to develop heart disease.

The term lipids is used to describe triglycerides, phospholipids, sterol esters, and free fatty acids. Triglycerides are the major component of fats. Phospholipids, like triglycerides, are fatty acid esters of glycerol-phosphate.
The phospholipids are natural emulsifiers, and are thus apparently important as transporters of water-insoluble fatty materials throughout the body. Cholesterol is a sterol characteristically found in animal fats. The blood and most body cells normally contain phospholipids and sterols, including cholesterol. Pathological conditions are likely to develop as the levels of these substances exceed normal values. High levels are strongly associated with development of atherosclerosis (3).

**Lipid Metabolism and Dietary Fiber**

Fiber appears to affect the rate and route of absorption and metabolism of lipid. Portman and Murphy (17, 18) found that, when rats were fed a semipurified, fiber-free diet containing starch, they excreted 72 per cent less cholic acid and 36 per cent less neutral steroid than when fed commercial diet. Kritchevsky et al. (2) concluded that intestinal absorption of cholesterol is lower in rats fed a stock diet than in those fed a semisynthetic diet. Leveille and Sauberlich (15) demonstrated that the hypocholesteremic response of pectin feeding was closely linked to decreased enterohepatic circulation of bile acids. Eastwood and Boyd (6) examined bile salts in terms of their distribution between the soluble and insoluble material in the small intestine of the rat. They found that appreciable quantities of bile salts were bound to the insoluble material and
surmised that this would account for differences in amounts of bile salts found in different parts of the intestine. It appears that dietary fiber can alter the relative sizes of the various bile salt pools. These changes are, at least in part, a result of interactions between bile salts, fiber, and intestinal flora—interactions that result in an increased excretion of all or some of the bile salts in the feces. Changes in bile salt metabolism that result from changes in the type and amount of fiber administered seem to be related to the levels of cholesterol in blood and bile.

Although dietary fibers are generally considered as a group, they do not exert similar systemic effect (25, 30, 31). Truswell and Kay (28) found that plasma cholesterol was not lower in cholesterol-fed animals who were given up to 20 per cent of bran compared with fiber free controls. Kritchevsky and Story (13) compared the binding of taurocholate and glycocholate by several types of fiber commonly used in animal diets. Alfalfa bound an appreciable quantity of taurocholate and wheat straw, bran, and oat hulls bound small quantities of taurocholate. Cellulose and cellophane did not actively absorb taurocholate.

Cellulose has little effect on lipid metabolism in experimental animals. Well and Ershoff (32) added five per cent cellulose to a rat diet containing sucrose, cottonseed oil, casein, and one per cent cholesterol. Serum cholesterol
level rose by thirty per cent and liver cholesterol level by twenty-five per cent. A similar effect was observed by Tsai et al (29). They added seven per cent cellulose to the diet of rats fed 0.5 per cent cholesterol. They observed no effect on serum cholesterol levels but a thirty per cent rise in liver cholesterol content. Story and Kritchevsky (23) found that a slight hypercholesteremic effect in rats fed one per cent cholesterol and five per cent cellulose.

Pectin, on the other hand, significantly reduced liver cholesterol levels in rats fed one per cent cholesterol diets (16, 13, 8, 2).

Kay and Truswell (9) suggested that the presence of mucilagenous substances, such as pectin, in the lumen of the small intestine would interfere with the equilibrium between the micellar phase and the molecular phase which passes into the unstirred layer on the brush border and in this way might reduce the absorption of lipids. Reddy (19) reported that addition of pectin to the diet increased the concentration and daily output of fecal neutral sterols and bile acids compared to that of control diet.

Current literature reveals that dietary fibers do not all exert similar effect in the small intestine. Cellulose and wheat bran have not lowered plasma cholesterol and have not increased fecal lipid excretion. Pectin, on the other
hand, significantly reduced serum and liver cholesterol and increased fecal lipid excretion.


CHAPTER III

PROCEDURE OF METHODOLOGY

Population and Sample Selection

Seventy weanling Holtzman Pseudopregnant male rats were used. Animals were fed on a basal fiber-free diet (Table II) for one week. At the end of week one, the body-weight was 90-120 gm. After the first week they were allocated to experimental groups (ten rats/group, two rats/cage) as follows:

- Group #1 were fed with basal diets plus 7.5 per cent oat bran,
- Group #2 were fed with basal diets plus 10 per cent oat bran,
- Group #3 were fed with basal diets plus 7.5 per cent pectin,
- Group #4 were fed with basal diets plus 10 per cent pectin,
- Group #5 were fed with basal diets plus 7.5 per cent cellulose,
- Group #6 were fed with basal diets plus 10 per cent cellulose, and
- Group #7 (control group) were fed with basal diets only.
TABLE II
COMPOSITION OF BASAL DIETS*

Ingredients

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn oil</td>
<td>2.0</td>
</tr>
<tr>
<td>Gelatin</td>
<td>8.0</td>
</tr>
<tr>
<td>Glucose</td>
<td>46.0</td>
</tr>
<tr>
<td>Hydrogenated vegetable oil</td>
<td>18.0</td>
</tr>
<tr>
<td>Salt mixture</td>
<td>6.0</td>
</tr>
<tr>
<td>Vitamin free casein</td>
<td>20.0</td>
</tr>
</tbody>
</table>

*Haas, et al., Virology, 3, 15 (1967). Fortified with total vitamin supplement at the rate of one kilo per 100 lbs. of diet.

Methods and Sources of Data

The animals were given the experimental diets for five weeks; food and water were allowed ad libitum. Body-weight and food consumption were recorded weekly. Feces from each cage were collected daily, weighed, 8 gm samples were taken, covered and stored at -15°C for water content and total fat analysis. Dry weight of feces was determined by freeze-drying method, and then a 2 gm sample was used for total fecal fat analysis. Total fecal fat was measured by the official method of the Association of Official Agricultural Chemists (2).

Treatment of Data

The data was expressed as a means ± SEM and analyzed statistically by two-tailed t test (1, 3).
CHAPTER BIBLIOGRAPHY


CHAPTER IV

RESULTS AND DISCUSSION

Results

Animals fed the diets containing 10 per cent pectin gained significantly less weight than the animals fed the control diets (Table III). However, body weight gain did not differ between animals fed the control diet and those fed diets containing 7.5 per cent oat bran, 10 per cent oat bran, 7.5 per cent pectin, 7.5 per cent cellulose, or 10 per cent cellulose. Food intakes were not significantly different between control group and the other groups (Table III).

TABLE III

FOOD INTAKE AND WEIGHT GAIN IN RATS FED VARIOUS FIBERS

<table>
<thead>
<tr>
<th>Group</th>
<th>Food Intake (g/5wk/rat)</th>
<th>Weight Gain (g/5wk/rat)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>519.0 ± 28.52*</td>
<td>242.2 ± 17.70</td>
</tr>
<tr>
<td>Group 2</td>
<td>520.6 ± 18.84</td>
<td>245.2 ± 22.43</td>
</tr>
<tr>
<td>Group 3</td>
<td>553.4 ± 26.33</td>
<td>240.2 ± 21.04</td>
</tr>
<tr>
<td>Group 4</td>
<td>520.6 ± 13.43</td>
<td>217.8 ± 7.89**</td>
</tr>
<tr>
<td>Group 5</td>
<td>541.0 ± 33.99</td>
<td>224.2 ± 21.1</td>
</tr>
<tr>
<td>Group 6</td>
<td>562.2 ± 25.18</td>
<td>238.0 ± 7.75</td>
</tr>
<tr>
<td>Group 7</td>
<td>579.4 ± 75.13</td>
<td>238.4 ± 18.23</td>
</tr>
<tr>
<td>(control)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Mean ± SEM  
**Significantly different from the control group at p < 0.05.
On wet matter basis, animals fed the diets containing 7.5 per cent pectin, 10 per cent pectin, 7.5 per cent cellulose, and 10 per cent cellulose excreted significantly more feces than those fed the control diet (Table IV). There were no significant differences in wet fecal weight between the rats fed 7.5 per cent and 10 per cent oat bran. On dry matter basis, animals fed the diets containing 10 per cent pectin, 7.5 per cent cellulose, and 10 per cent cellulose excreted significantly more feces than those fed the control diet (Table IV). There were no significant differences in dry fecal weight between the rats fed the control and 7.5 per cent oat bran, 10 per cent oat bran, and 7.5 per cent pectin diets.

**TABLE IV**

WEIGHT OF WET AND DRY FECES IN RATS FED VARIOUS FIBERS

<table>
<thead>
<tr>
<th>Group</th>
<th>Wet Fecal Weight (g/5wk/rat)</th>
<th>Dry Fecal Weight (g/5wk/rat)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>52.38 ± 5.80</td>
<td>36.94 ± 2.68</td>
</tr>
<tr>
<td>Group 2</td>
<td>56.52 ± 2.46</td>
<td>40.21 ± 2.0</td>
</tr>
<tr>
<td>Group 3</td>
<td>68.72 ± 7.65*</td>
<td>51.13 ± 3.87</td>
</tr>
<tr>
<td>Group 4</td>
<td>77.2 ± 11.48*</td>
<td>52.28 ± 3.01*</td>
</tr>
<tr>
<td>Group 5</td>
<td>105.24 ± 11.16*</td>
<td>74.92 ± 6.43*</td>
</tr>
<tr>
<td>Group 6</td>
<td>123.44 ± 8.8*</td>
<td>89.19 ± 5.99*</td>
</tr>
<tr>
<td>Group 7</td>
<td>54.06 ± 6.18</td>
<td>44.0 ± 6.89</td>
</tr>
<tr>
<td>(control)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significantly different from the control group at p < 0.05.
The effect of various diets on fecal fat excretion is shown in Table V. Animals fed the diets containing 10 percent pectin resulted in a significant increase in the output of total fecal fat compared to the control group. There were no significant differences in the fecal fat output of rats between the control group and the diets containing oat bran and cellulose groups.

**TABLE V**

**Fecal Fat Excretion in Rats Fed Various Fibers**

<table>
<thead>
<tr>
<th>Group</th>
<th>Fecal Fat Excretion (g/5wk/rat)</th>
<th>% Fecal Fat Excretion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>3.33 ± 0.64</td>
<td>8.18 ± 0.92</td>
</tr>
<tr>
<td>Group 2</td>
<td>3.398 ± 0.5</td>
<td>8.16 ± 0.95</td>
</tr>
<tr>
<td>Group 3</td>
<td>4.498 ± 1.70</td>
<td>8.684 ± 2.68</td>
</tr>
<tr>
<td>Group 4</td>
<td>5.638 ± 0.90*</td>
<td>10.77 ± 1.17</td>
</tr>
<tr>
<td>Group 5</td>
<td>3.363 ± 1.346</td>
<td>3.91 ± 1.21*</td>
</tr>
<tr>
<td>Group 6</td>
<td>2.78 ± 0.84*</td>
<td>2.78 ± 1.09*</td>
</tr>
<tr>
<td>Group 7</td>
<td>4.01 ± 0.71</td>
<td>9.84 ± 2.16</td>
</tr>
</tbody>
</table>

*(control)*

*Significantly different from the control group at p < 0.05.*

**Discussion**

The diets were not necessary isocaloric. The data presented here indicate that dietary fibers do not exert similar effects. These results are in agreement with recent studies on man and rats (6, 7, 8, 9, 10).
Dietary Fiber and Body Weight Control

The results of this study indicate that 10 per cent pectin diets gained less weight (p < 0.05) than the others (oat bran, cellulose, and control group). Because there were no significant differences in food intake of each group, the effect of pectin may result in an increased total fat (Table V) and bile acid excretion (3, 5), and an increased conversion of cholesterol to bile acids to compensate for their increased fecal loss (2).

Dietary Fiber and Bulk-Promoting Property

This study showed that the pectin and cellulose groups produced significantly more feces than the control group. Dietary fiber is the residue derived from plant cell walls that is resistant to hydrolysis by human alimentary tract enzymes (12). Rats, whose digestive system is similar to that of humans, excreted higher fecal residue with increased fiber diets as compared to low fiber diets. The fecal bulk-promoting property of this study agrees with results of previous reports (1, 4).

Dietary Fiber and Fecal Fat Excretion

The result of this study indicates that dietary cellulose decreased the concentration of fecal fat, as compared to the control diet. The oat bran group showed no significant difference in regard to fecal fat excretion as compared to the control diet. In contrast, feeding of
pectin markedly increased not only the concentration but also the daily output of fecal fat. Although the mechanism by which pectin enhances fecal neutral sterol and bile acid excretion has not been elucidated, Kay and Truswell (3) suggested that the presence of mucilagenous substances, such as pectin, in the lumen of the small intestine would interfere with the equilibrium between the micellar phase and the molecular phase which passes into the unstirred layer on the brush border and in this way might reduce the absorption of lipids.

The observed differences in total fecal lipids excretion in rats fed a variety of fibers may be explained, in part, on the basis that the different types of fibers and their isolated components bind fat, cholesterol and individual bile acids differently. The absorption process is complex and varies dependent on source and composition of dietary fiber (11).


CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The primary purpose of this study was to determine the effect of various types and amounts of dietary fiber on lipid absorption and utilization. The study was designed to permit conclusions to be drawn concerning the following problem:

1. to analyze the effect of various types and levels of dietary fiber on fecal lipid excretion,
2. to analyze the effect of various types and levels of dietary fiber on body weight control, and
3. to analyze the effect of various types and levels of dietary fiber on fecal weight.

Seventy weanling rats were used in this study. Animals were randomly divided into seven dietary groups: (1) basal diets plus 7.5 per cent oat bran, (2) basal diets plus 10 per cent oat bran, (3) basal diets plus 7.5 per cent pectin, (4) basal diets plus 10 per cent pectin, (5) basal diets plus 7.5 per cent cellulose, (6) basal diets plus 10 per cent cellulose, and (7) control group, basal diets only. All animals were given food and water ad libitum for a period of five weeks. Animal weight and food intake were
recorded at weekly intervals. Each group's feces were collected weekly, covered and stored at below -15°C. The fecal samples were freeze-dried and dry matters were estimated. Total fat was measured in dried fecal sample by the official method of the Association of Official Agricultural Chemists.

The data for each subject in this study were punched on IBM cards and statistical computations were made at the computer center at North Texas State University (1).

Conclusions

From the data analysis, the following conclusions could be drawn.

1. Although dietary fibers are generally considered as a group, they do not exert similar systemic effects.

2. Food consumption was not significantly altered by the inclusion of oat bran, pectin or cellulose.

3. Rats fed on the diets containing 10 per cent pectin gained significantly less weight than did the animals fed the control diets. However, body weight gain did not differ between animals fed the control diets and those fed diets containing oat bran or cellulose.

4. Fecal weight was significantly greater in pectin \((p < 0.05)\) and cellulose \((p < 0.05)\) groups than the control group. There was no difference in fecal weight between the rats fed the control diets and oat bran diets.
5. Rats fed on the diets containing pectin excreted more fat in their feces than did rats fed on the control group. There was no difference in fecal fat excretion between the control group and oat bran group or cellulose group.

Recommendations

Additional research relative to the present study is needed. The following recommendations are suggested.

1. Extension of time might produce changes that were not noted in a shorter time period.

2. The role of dietary fiber in fat, cholesterol and bile acid metabolism is complex and needs further study.

3. The minimum amount of dietary fiber necessary for the human body remains to be determined.

4. The effect of dietary fiber on other nutrient absorption and utilization needs further study.

5. The animal group fed pectin supplement showed the least amount of weight gain. Further research on dietary fiber's effect on obesity is needed.
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Books


Articles


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