

1937

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COOPERATIVE EXTENSION WORK
IN AGRICULTURE AND HOME ECONOMICS

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FOODS FOR DIABETICS

Prepared by William J. Mallory, M. D.

(Used by Dr. Mallory at George Washington University Hospital Clinics to aid patient or family in carrying out the Doctor's directions; furnished him to the Red Cross Nutrition Service for use with diabetic ex-service men from U. S. Veterans' Bureau Hospital, Lake City, Florida.)

What is Diabetes

In diabetes there is a decreased capacity to utilize sugar and sugarforming foods. Diabetes is not a disease of digestion nor of the kidneys.

Food is digested and absorbed, but sugar is not stored in the liver in the normal manner, nor is it consumed or burned up in the body in full amount. As a result of this the sugar in the blood is increased above the normal level and is excreted in the urine. (Glycosuria.)

This condition is dependent upon a deficiency in the internal secretion of the pancreas (Insulin), which may be slight, causing mild diabetes, or it may be very great, causing serious disturbance in nutrition, leading to a number of grave complications.

The increase of sugar in the blood above the normal level seems to cause a number of complications. Certainly these conditions are benefitted by restoring the blood sugar to its normal level. Many of them disappear entirely, some are markedly improved, and others are arrested in their course.

With a failure to utilize the normal amount of sugar, the utilization of other forms of food becomes impaired. For example, fat is consumed completely only when a sufficient proportion of sugar is burned. This ratio is one of sugar to one and one-half of fat. That is to say, if a patient can utilize completely only 100 grams of sugar, he can utilize completely only 150 grams of fat. If more than 150 grams of fat is taken, or if less than 100 grams of sugar is burned, the fat is not completely burned up and certain acid substances (Acetone and Diacetic acid) are formed in the body, and this produces the condition known as "acidosis," which may lead to coma and death unless controlled.

Symptoms

Symptoms suggestive of diabetes are: thirst, passage of a large amount of urine, increased hunger, and loss of weight. However, there are a great many cases in which these symptoms are absent and the person complains of being tired, has rheumatic pains, neuritis, weakness, itching of the skin, boils, carbuncles, and impaired vision. Any of these symptoms should arouse suspicion and lead to examination by a physician.

The simplest method of recognizing the disease is by testing the urine for sugar. This is not infallible, for sugar may be present in the urine at one time, and absent at another time, depending partly upon the amount of food taken. It is therefore best to use for the test a sample from the whole 24-hour quantity of urine.

Tests

When the disease is suspected it is well to examine the blood also, to determine the amount of sugar present. This is necessary because there are many diabetics whose blood contains two, three or even four times the normal amount of sugar and yet none may be excreted in the urine. The degree to which the sugar in the blood must be increased before it is excreted in the urine varies greatly with different individuals. Generally the level of overflow is higher in older people with impaired kidney function, but high blood sugar values without sugar in the urine also occur in the young.

If diabetes is found, the next step is to determine the degree of severity. This can only be accomplished by some form of "tolerance test" or "test diet." That is, the patient is given a diet containing not only the articles of food to be eaten but the amount of each must be weighed or measured. Such a diet will contain a known amount of sugar-forming foods (carbohydrates (C.H.), as well as of protein (P.) and fat (F.).

If such a diet contains in the daily ration 2 ounces of carbohydrate and 1 ounce is found to be excreted in the 24-hour urine, we know that at that time, at least, the patient is able to utilize only one ounce of sugar per day, and his further management must be based upon this limited tolerance of carbohydrate. There is no other way of knowing whether a case is mild or severe. One's feelings, weight, appearance, etc. are not reliable guides but, on the contrary, are often very misleading.

Relation of Diet to the Disease

Sudden changes in the diet are dangerous. Alterations should be made cautiously, with a knowledge of the patient's condition and an understanding of the composition of the diet in terms of carbohydrate, protein and fat.

Drugs will not relieve the diabetic of troublesome symptoms, nor, if there are no symptoms, save him from the danger of complications. Proper diet will do both of these things.

Why should any one undergo the inconvenience of dieting simply because the doctor has found sugar in the urine?

(1) Because, with the exception of a few rare conditions which can be determined only after careful examination by a physician, sugar in the urine means a serious disturbance of the nutritive processes of the body.

(2) If the condition is neglected until it has progressed to the point of troublesome symptoms, the difficulties of the physician and dangers to the patient are much greater.

(3) Diabetes untreated tends to become more and more severe. Some cases progress from mild to severe slowly; some become severe suddenly.

(4) Patients with diabetes are especially prone to certain complications; that is, diseased conditions developing as a result of diabetes but presenting entirely new symptoms, difficulties and dangers.

(5) The treatment of either mild or severe diabetes, with or without complications, is by diet.

(6) If proper diet is instituted promptly, the problem is usually simple and easy.

In the beginning the physician should determine the tolerance of the patient and upon that construct a diet which will meet satisfactorily the patient's needs as well as his limitations. But it is necessary that the patient should understand enough about this disease and diet to carry out instructions, in the first place, and later to become more and more independent and capable of managing his diet with occasional reports to his physician.

Under normal conditions one may eat as much as he wants of any and all kinds of food in various relative proportions, and the functions of digestion, absorption and utilization will adapt them selves to great degrees of variation without obvious disturbance. In disease this is not so.

In diabetes, in particular, there is a limit to the amount of sugar-forming foods that can be utilized, and this in turn, as already explained, limits the amount of other foods that may be taken with safety.

Precautions

Attempts to remedy disturbed functions of the body should be made intelligently; that is, with an understanding of the kind and degree of alteration, the means to be employed, and the effect to be produced by them. Our bodies are complex chemical factories and unintelligent experimentation with the diet of a diabetic may destroy the whole plant and with it the patient's life. At present enough is known about the chemical processes of the body to guide us intelligently in managing its nutrition in health and disease.

The nutrient value of foods (heat and energy-producing value) is reckoned in calories, or units of energy.

1 gram	Carbohydrate	burned produces 4 calories.
1 gram	Protein	burned produces 4 calories.
1 gram	Fat	burned produces 9 calories.
1 gram	Alcohol	burned produces 7 calories.

This is the same, whether the burning takes place outside the body or inside the body; whether burned quickly or slowly.

The amount of energy necessary, per day, for the human body at rest is about 25 calories per kilogram of body weight. Therefore, a man weighing 150 pounds or 68 kilograms, would require 1700 calories. The requirement would be greater in proportion to the amount of exercise taken.

In addition to a sufficient amount of energy-producing foods (carbohydrate, protein and fat), the body requires fluids, salts and certain substances known as vitamins. A normal mixed diet contains sufficient salts and vitamins and these need not be calculated in the diabetic diet.

The heat and energy requirements of the body may be supplied by any one of the food substances (carbohydrate, protein and fat) or any mixture of them, but there is only one that will provide material for growth and the replacement of wear and tear of body tissue, and that is protein. The amount of this required is at least 0.66 gram per kilogram of body weight. This may be reduced temporarily, if necessary, but as a permanent ration 1 gram per kilogram of body weight is safer and not excessive.

Therefore, a man weighing 150 pounds, or 68 kilograms, would need 68 grams of protein per day. If more were taken than which was needed to rebuild tissue would be so utilized and the remainder burned and utilized as a source of energy or heat. However, an excessive amount of protein is not an economical source of energy, and in diabetics especially, it should be limited, because 58 per cent of protein is converted into sugar and must be burned as such.

If an insufficient amount of protein is taken there is a gradual loss from the tissues of the body, for while carbohydrate and fat can be used as sources of energy, they do not rebuild body tissues.

Carbohydrate is the most easily assimilated of all foodstuffs. When used in the body it supplies heat and energy and is called a "protein sparing" food because, if given and utilized in amount sufficient to supply all the energy and heat required, the protein of the body tissues is not attacked and used as a supply of energy.

Fats behave very much as carbohydrate, but as already mentioned, there is a limit to the amount of fat which can be utilized by the diabetic.

From what has been said it is apparent

- (1) That a diabetic is limited in the amount of carbohydrate that may be taken with safety.
- (2) Since 58 per cent of protein is converted into sugar in the body, the amount of protein is also limited.
- (3) Fat is also limited by the amount of carbohydrate burned.
- (4) So there is no single article of food which the diabetic may take in unlimited amounts without suffering bad consequences.

The diet must contain the right proportions of each kind of food and the total amount must be neither too small nor too great.

How to Estimate the Diet

Suppose that a diabetic, weighing 150 pounds, or 68 kilograms, is found to burn only 50 grams of carbohydrate as such; that is, as sugar and starches. Of what should his whole diet consist? In the first place he must have 68 grams of protein to replace the wear and tear of body tissues. Nothing can serve as a substitute for this. Then the patient can have 50 grams of carbohydrate and 68 grams of protein; but of this 68 grams of protein, 58 per cent or 39 grams, goes into sugar and is used in the body as such. Therefore, his total intake of carbohydrate, known as total dextrose (T.D.), is 50 plus 39, or 89 grams. His total dextrose intake of 89 grams, if burned completely, would allow fat to be used to the amount of 1 and 1/2 times the total dextrose; $89 \times 1.5 = 133$. This 133 grams is the maximum amount and should not be given at first, but the fat should be gradually increased and the effects observed. In diacetic acid appears in the urine, the limit has been reached and the fat should then be reduced.

If the above amounts are used completely and no diacetic acid or sugar appears in the urine, and the blood sugar remains normal in amount, the problem has been solved, provided this is sufficient for the patient to maintain health, strength and normal weight. The total intake would then be as follows:

50 grams	C. H.	x 4	200 calories
68 grams	P.	x 4	272 calories
133 grams	F.	x 9	1197 calories
			1669 calories

The patient weighing 150 pounds, or 68 kilograms, would be receiving 1669 calories. We have seen that a man weighing 68 kilograms requires (68 x 25) 1700 calories, at rest. If this weight is normal for this man and he goes to work he will probably lose weight. Then what should be done? If we add carbohydrate, sugar appears in the urine and his blood sugar goes above normal. There are, then, at least two possibilities. We may allow him to lose weight to 10 or 20 per cent below his calculated normal, down to 54 kilograms. This would require (54 x 25) 1350 calories, at rest. But suppose, at 54 kilograms weight, and on 1700 calories as above, he still loses weight on account of necessary activity, and the addition of carbohydrate causes increase in the blood sugar and sugar in the urine. What then is to be done?

Insulin may be given in sufficient amount to permit the addition of the necessary amount of carbohydrate to the diet, which will, in turn, permit the addition of some fat, thus raising the total caloric intake.

Five units of insulin will usually provide for the utilization of 10 grams of carbohydrate. The diet would then be as follows:

60 grams	C. H.	x 4	240 calories
68 grams	P.	x 4	272 calories

The total dextrose would now be 60 grams of carbohydrate, as such, plus 39 grams (58 per cent) derived from the 68 grams of protein; that is, 99 grams of carbohydrate. This would allow (99 x 1.5) 148 grams of fat,

148 grams F. x 9 1332 calories

or a total of 1844 calories.

This maneuver may be repeated till the total intake is sufficient to meet the needs of the patient.

All of the above calculations are approximate. For example, 10 per cent of fat goes into sugar and may be considered in the calculation; but the examples given are sufficiently accurate to serve as an illustration of the principle involved and to work with in making up a diet for actual use by a patient. Changes in the diet, increase or reduction, as well as the dosage of the insulin, must be adjusted to the individual patient under treatment. Each and every patient presents an individual problem and must be treated accordingly.

Patients frequently ask: "May I have milk, or gluten bread?" The answer to all such questions is the same. The diabetic can really take some of any article of diet that may be named, with the following provisions:

- (1) That he knows what the food contains in carbohydrate, protein and fat.
- (2) If the article be added, the corresponding amount of other food be omitted. For example, 1 ounce, or 30 cc, of sweet milk contains approximately C. H. 1.5; P. 1; F. 1. grams. A glass of 6 ounces of milk, C. H. 9; P. 6; F. 6. So, if the patient takes a glass of milk, he must omit an equal amount of carbohydrate, protein and fat in some other form.

The various commercial diabetic foods should only be used under the same restrictions. It is not sufficient that the article is marked pure or "For Diabetics". The amount of carbohydrate, protein and fat it contains must be known and then it should be used with the same restriction as any other food. There are, however, a number of articles without food value which may be used as "fillers" or for their comforting effect. The following substances have no food value:

Mushrooms	Fat-free broth
Jerusalem artichokes	Washed wheat bran
Bouillon cubes	Mineral oil
Tea	White wine vinegar
Coffee	

The details of calculating the diet and the methods of substituting one food for another are usually taught while the patient is in the hospital, and after he leaves the instruction is continued at regular class conferences.

Insulin and Its Use

"Insulin", as supplied by the druggist, is a clear, watery solution containing the active principle of the internal secretion of the pancreas. It is usually dispensed in sealed vials of 5 cc or 10 cc. There are several strengths of insulin on the market, known as

- U 10 - 1 cc of which contains 10 units
- U 20 - 1 cc of which contains 20 units
- U 40 - 1 cc of which contains 40 units
- U 80 - 1 cc of which contains 80 units
- U 100 - 1 cc of which contains 100 units

Protamin Zinc Insulin is sold in strengths of U 40 and U 80

Insulin is prepared in these various concentrations for convenience in administering. In order to produce satisfactory results, insulin must be injected hypodermically (under the skin.)

Now if it were desired to give 10 units, one might use - 1 cc of U 10, or $\frac{1}{2}$ cc of U 20, or $\frac{1}{4}$ cc of U 40, etc. Whereas if it were necessary to give 40 units, and we had only U 10, it would require 4 cc, which is about a teaspoonful, an inconveniently large amount to inject under the skin, especially when, as is sometimes the case, it must be used two or three times a day. A dose of 40 units given in the form of U 40 would be 1 cc, which is a convenient amount to inject, if so much is needed.

A unit of insulin, whether from U 10, U 20 or U 40, will provide for the utilization of about 1.5 to 2 grams of carbohydrate. Therefore, if a patient has been using U 10, taking 10 units (1 cc) at a dose, and should change to U 20, he should be careful to see that he gets, not 1 cc, which would contain a double dose, but $\frac{1}{2}$ cc, which would contain his usual dose of 10 units,

Whether insulin is used in a given case or not should be determined by the physician in charge. Likewise, the amount to be given should be decided by him and, any increase made under his explicit directions. The reason for this caution is that insulin, fortunately for the diabetic, is a very potent remedy. The right amount at the right time will produce marvelously satisfactory results. A dose too large may destroy life.

The effect of insulin when injected is to produce oxidation (burning, or utilization) of sugar in the tissues of the body. If too much is given at one time or if doses are repeated too frequently the amount of sugar in the blood and tissues may be reduced to a level so far below the normal that life cannot be continued.

Fortunately, before life is endangered, a number of characteristic symptoms occur, which those who are instructed may easily recognize and relieve. See page 8.

When the patient is first given insulin and the dose is being gradually adjusted to the required amount, it is much better for the patient to be in the hospital where he is under observation of doctors and nurses. During this time he can be taught how to measure the dose in the syringe and should learn to inject the dose correctly himself; then, when the diet and dose of insulin have been adjusted and the patient knows both of these he may continue his treatment at home, with occasional reports to doctor.

Fortunately, diabetes is a chronic disease, and those suffering with it rarely die of the disease itself, but it predisposes to a number of complications which may be trivial to the normal person but are a menace to the life of a diabetic.

Infection should probably be mentioned first, because its prevention depends so much upon the patient himself. He can prevent, but should never undertake to treat infections. Corns, callouses, and the tissue of low vitality about the toes are a common site of beginning trouble. These, apparently trivial at first, if not properly attended, sometimes cause weeks or months in bed, the loss of a limb, and even death.

The shoes should be amply large and well fitting, not pointed, narrow or tight, because pressure limits the circulation of blood and so lowers the vitality of the tissues.

The feet should be kept scrupulously clean by washing frequently in warm water with a mild soap and then drying thoroughly but gently with a soft cloth. Elderly people especially should wear thick soft stockings, which should be changed frequently.

Corns, bunions and callouses should never be cut, because so frequently a slight wound is made and serious trouble begins. Instead of cutting them, a piece of toilet pumice stone should be used and the hard callous tissue gently and lightly polished off. Fissures and cracks between the toes should be frequently sponged with medicated alcohol. The nails should be cut with care, avoiding cutting to "the quick" or gouging in the delicate tissues at the corners of the nails.

Any redness, swelling or pain about the toes or feet, black spots on the toes or heels, or infected wounds should be reported to the doctor immediately. Harsh antiseptic and greasy salves should not be applied. Remove the shoe, apply a loose bandage, keep the feet at rest, and send for the doctor.

Coma is a most serious complication. It may be induced in the diabetic by sudden changes in the diet, and is especially liable to occur in association with some infection. Marked drowsiness, deep breathing, and nausea and vomiting should warn one of danger. The physician should be called at once.

WHAT EVERY DIABETIC PATIENT SHOULD KNOW

1. How to test the urine for sugar.
2. How to calculate the diet in terms of carbohydrate, protein and fat, in calories (Taught in clinics.)
3. Common measurements as applied to diabetes.
4. The danger of apparently trivial symptoms.
5. Know your weight and do not exceed it.

IF TAKING INSULIN:

6. How to measure and administer your dose of insulin (Taught in hospital or by physician.)
7. How to recognize the insulin reaction and the remedy (Taught in the clinic.)
8. What to report to the doctor.

TEST FOR SUGAR IN THE URINE

Place 5 cc (or 1 teaspoonful) of Benedict's qualitative solution in a test tube, add 8 drops of urine, shake to mix. Place the test tube containing the mixture in boiling water and boil continuously for 5 minutes. If there is no sugar present in the urine the solution in the test tube remains clear as before boiling. If sugar is present, a greenish cloudy precipitate indicates a trace of sugar; a yellow precipitate indicates about 1 per cent; a red sediment indicates more.

TEST FOR DIABETIC ACID IN THE URINE

Place in a test tube about 1 teaspoonful of 10 per cent solution of ferric chloride. Add to this the urine to be tested, drop by drop. A cherry red color indicates the presence of diacetic acid. NOTE: If the patient has been taking aspirin, diacetic acid will appear in the urine without relation to diabetes or acidosis.

A calorie is the amount of heat required to raise the temperature of one litre of water one degree Centigrade.

A person at rest requires about 25 calories per kilogram of body weight per day.

A kilogram is 2.2 pounds, or 1000 grams.

A gram is 15 grains. 4 grams, or 4 cc, is about 1 teaspoonful.

A buffalo nickel weights 5 grams. 30 grams is about 1 ounce.

30 cc is about 1 ounce, liquid measure.

The amount of sugar in the normal blood varies with the ingestion of food and other factors, from 85 to 120 milligrams per 100 cc of blood.

If blood is examined in the morning before breakfast, that is, after a fast of about 12 hours, it is normally about 100. Therefore, when, the blood is to be

examined for sugar, it should be taken in the morning, before breakfast, and if the patient has been taking insulin, this should be postponed until after the blood is taken and the patient is ready to take breakfast.

DANGER OF TRIVIAL SYMPTOMS

In a diabetic patient what seem to be trivial conditions may produce serious consequences. Therefore, report to your physician promptly colds, fevers, digestive disturbances, any slight injury to the skin of the hands or face, and boils.

SYMPTOMS OF INSULIN REACTION

This may occur under a number of different conditions:

1. Taking insulin too long before meals. Insulin should be taken 20 minutes before meals. NEVER LONGER THAN THIS.
2. Taking too large a dose of insulin, i.e., when one is getting better of diabetes and the previous dose is more than is necessary.

SYMPTOMS: Sudden and pronounced hunger. Sudden weakness and fatigue. A peculiar restlessness or nervousness, often described by the patient as a feeling of inward trembling. Pallor or flushing of the face. Dilated pupils. These are the early symptoms and will disappear quickly if the patient will take a little carbohydrate, such as the juice of an orange, two or three pieces of candy, a lump of sugar, or a tablespoonful of syrup.

If these corrective measures are not adopted, the following symptoms may follow: Sweating, tremor, excitement and emotional disturbances, dizziness and double vision.

ON REPORTING TO YOUR PHYSICIAN ALWAYS BRING THE FOLLOWING INFORMATION:

1. Weight in ordinary clothing.
2. Diet in terms of carbohydrate, protein and fat, giving the total caloric value.
3. Specimen of a 24-hour collection of urine, with a record of the total amount passed in this time.
4. If taking insulin, the number of units.

INSTRUCTIONS FOR DIABETICS USING INSULIN

1. Do not depart from the diet or the dose of insulin unless your physician so advises.
2. Should complications occur, notify your physician promptly.
3. Remember the symptoms of insulin reaction and the remedy.
Always have carbohydrate in some form readily available.
4. If vomiting or diarrhea occur, or a meal is omitted for any cause, discontinue the insulin temporarily.
5. Know your normal weight and never exceed it.
6. Always have some insulin on hand.