BIOCHEMISTRY

Sugars Protect Enzymes

Biochemists at the American Chemical Society meeting reported on research such as protecting enzymes against X-radiation damage and controlling cholesterol in the diet.

➤ SUGARS have been found to protect delicate enzymes from the harmful effects of X-rays, three Syracuse University biochemists reported at the American Chemical Society meeting in New York. (See pp. 179 and 184.)

Drs. Trevor Robinson, A. W. Phillips and Shirley Dilg, Biological and Food Research Laboratories and department of bacteriology and botany, Syracuse University, also suggested two possible ways in which the sugars protect enzymes.

In laboratory tests, the scientists irradiated several enzymes with X-rays until the enzymes were only half as active as normal. The same X-ray dose was then administered to enzymes mixed with sugars.

The biochemists found sugars had a protective effect in amounts as low as or even lower than those required for previously discovered sulfhydryl protective compounds.

Enzymes, intricate compounds produced in living cells, are vital to life processes because of their ability to break down complex substances into simpler materials that can be used by a living body. Most enzymes are extremely sensitive to changes in their surroundings, and to various types of radiation that render them inactive. Important body functions stop when the activity of responsible enzymes is lowered, as in the case of X-ray overdoses reaching some enzymes.

Many enzymes are dependent for their activity on the presence of organic sulfhydryl groups, compounds containing sulfur-hydrogen radicals. Such compounds have been used to protect enzymes from X-irradiation in the past.

The Syracuse University scientists found that even some enzymes, such as catalase and aldolase, which do not depend on the presence of sulfhydryl groups for their activity, are also protected from X-ray effects by sugars.

Two possible explanations of the protective action were presented:

1. X-rays cause portions of the medium surrounding the enzyme to detach as free radicals, which in turn attach themselves to the enzymes with harmful effects. It is possible that sugars compete with enzymes for the free radicals, grabbing them before they can become attached to the enzymes.

2. The sugars are transformed into complexes that have an actual shielding effect.

➤ A GROUP of compounds that promises to prevent dental cavities by inhibiting chemical reactions in the mouth leading to tooth decay was reported to the meeting of chemists.

Chemicals that combat a bacteria and enzyme reaction on sugar deposits in the mouth were prepared synthetically and studied for dental use by Drs. Saul B. Needleman, Leonard S. Fosdick and R. Quentin Blackwell, chemistry department, Northwestern University Dental School, Chicago.

A generally accepted theory of tooth cavity formation, the scientists said, is that bacteria lodged on teeth contain enzymes capable of breaking down some sugar residues into weak acids, lactic acid and pyruvic acid, which attack teeth. The process is called glycolysis. The Northwestern scientists proceeded on the theory that any compounds able to prevent any step in glycolysis could inhibit formation of dental caries.

Thirty-six organic chemicals were prepared. The scientists found those containing a free carbon atom at the end of a carboxyl arrangement in their structures were highly effective in preventing glycolysis. The protein amino acids lysine and leucine proved most effective.

➤ HEART PATIENTS who want to keep track of the cholesterol in their diet may now find it as easy as counting calories with a list of the cholesterol content of many everyday foods.

This was presented by Dr. Isaiah S. Botwinick, Midtown Clinical Laboratory, New York, to the Chemical Society.

It will help in the easy substitution of low-cholesterol-content foods in the diet with a minimum of effort and expense, Dr. Botwinick said. The list will also aid the food and canning industry and enable them to answer the questions of physicians and dietitians about the cholesterol in processed foods.

An average daily menu for "Joe Smith, American," shows a healthy 150-pound male eats 600 milligrams (mg), or one-fiftieth of an ounce, of cholesterol in one day. This amounts to about 15% of the total cholesterol in the blood.

Here is the cholesterol content given for some common foods: one egg, 64.5 mg; two slices of enriched white bread, 15 mg; boiled ham, 2 lean slices, 103 mg; one teaspoonful mayonnaise, 17.3 mg; one ounce rye and four ounces ginger ale, none; four ounces lean sirloin steak, 94.8 mg; green peas, none, and cherry pie, 80 mg.

Until very recently patients who had abnormally high blood serum cholesterol levels were considered incurable.

But during the past year some of these patients have been on a low cholesterol diet with cholesterol-reducing substances and have had their blood serum cholesterol brought down to the normal levels, Dr. Botwinick said.

BIOLOGY

Prevent Radiation Death

➤ AN UNKNOWN substance in protoplasm has the ability of preventing death from atomic radiation.

Experimenting with one-celled amoebas, scientists at the Argonne National Laboratory, Lemont, Ill., were able to save 91% of the tiny animals with "clean" protoplasm after the animals had been subjected to continuous lethal doses of fission neutrons. The lethal dosage given the amoebae was described as "twice the amount that would be fatal to any animal," and this presumably includes man.

In the studies, protoplasm of varying amounts was transferred from non-irradiated cells to irradiated cells. The treated cells that survived, Drs. E. W. Daniels and H. H. Vogel Jr. reported to the American Institute of Biological Sciences meeting in Palo Alto, Calif., were capable of giving rise to large cultures of offspring.

Armed with the knowledge that protoplasm could prevent atomic death, the scientists then concentrated on discovering what parts or components of the protoplasm possessed this life-saving ability.

They put non-irradiated cells in test tubes and centrifuged them so that they whirled around at fantastic speeds. This was done to increase gravitational pull and cause a separation of some of the intracellular components. The cells stretched out with the light parts gravitating to one end, the heavy parts to the other end and the medium weight components in the middle.

The three separate components were then transferred to lethally irradiated cells.

The middle and heavy thirds of protoplasm showed they were as effective in preventing death as the whole protoplasm. The light elements, on the other hand, could do so only if they were not centrifuged beyond 5,000 to 8,000 times the pull of gravity for 10 minutes.

The light portions alone were thus as effective as non-centrifuged protoplasm in sustaining life so long as they were not whirled around above a certain limit. This is true, the researchers said, even though they contain no nuclei and very few mitochondrian, another type of cellular component.

In general, they found, the effectiveness of the light portions in preventing death decreases as the force of gravity increases.

One possible interpretation for their findings, Drs. Daniels and Vogel said, is that some component in the non-irradiated cell necessary to preserve life from atomic death is being whirled out of the light parts of the protoplasm.

This unknown life-saving substance, they infer, might be isolated and identified from the light components of protoplasm.