Reductone Production New Step in Maillard Reaction

Livestock industry loses $375 million annually to parasitic worms

KANSAS CITY.—Study of the browning reactions has resulted in discovery of a new reaction producing reductones from hexoses and amines, reported John E. Hodge of the Northern Utilization Research Branch, USDA. Hodge, speaking before the Carbohydrate Division at the recent ACS meeting here, said that the reductone-producing reaction is an important part of the Maillard reaction, initially demonstrated with sugars and amino acids.

Amino acids combine the amine reactant and the acid catalyst found necessary for reductone formation. "When the omnipresent amino acid encounters the ubiquitous reducing sugar, sugar-amine condensation, the Amadori rearrangement and dehydration of the sugar radical occur spontaneously to produce finally the dark polymers which we call melanoidins." Melanoidins are known to possess reducing power similar to reductones. Hexose-reductone may be the polymerizing unit which forms the melanoidins.

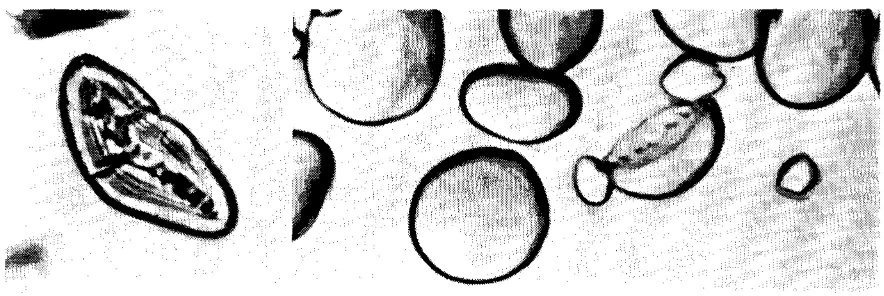
The reaction is a general one for hexoses and strongly basic secondary amines, said Hodge. Highest yields of piperidino-hexose reductone were obtained when one mole of hexose was heated with 1.3 moles of piperidine in absolute ethanol under nitrogen, with a weak, anhydrous acid catalyst. Maximum yields were 27 to 30% of theory.

Blood Volume Expanders from Okra. Investigation of the viscous mucilagenous dispersions water-extracted from crushed okra pods has been undertaken because of the potential use of the extract for blood volume expansion. Contained in the dispersions is D-galactose, L-rhamnose, and D-galacturonic acid, said Roy L. Whistler of Purdue University.

Partial acid hydrolysis followed by chromatographic separation give a crystalline galactobiose and an aldobiouronic acid. Methylation and periodate oxidation show the galactobiose to be 4-*o*-α-D-galactopyranosyl-D-galactopyranose. The high rotation of the disaccharide and the reduction in rotation during the course of hydrolysis suggest the alpha linkage, reports Whistler.

The products of lithium aluminum hydride reduction of the fully methylated aldobiouronic acid, followed by hydrolysis, show that the acid is 2-*o*-D-galactopyranosyluronic acid-L-rhamnose.

Wheat Starch Granule Structure. Cold water swelling of mechanically injured starch granules takes place at the point of injury, declares R. M. Sandstedt of the University of Nebraska. By means of time lapse motion photomicrographs Sandstedt and his coworkers followed the action of digestive enzymes and water on the granules, speeding or slowing processes by regulating the speed of the camera or projector.



Structure of starch granules as revealed by enzymatic digestion. Cross section of a granule; the pattern indicates areas of enzymatic activity. The larger picture (right) shows pitting along the middle portion of a granule which has been cut in half. Microphotographs from the paper presented by R. M. Sanstedt

Structure of the normal granule, shown by the slow action of enzymes, is layered. The alternating layers have varying resistance to attack. Granule has shape of flattened sphere, and point of least resistance is the wide middle layer, says Sandstedt. Injured granules have lost resistance to enzyme attack.

Parasitic Worms. Some 58 antihelminthics have proven valuable for treatment of the parasitic worms that cost more than $375 million each year in livestock losses, declared A. O. Foster of USDA. Of this number, 18 are primary antihelminthics; treatments of choice for specific helminthiases or worm conditions, said Foster, in the Medicinal Division's Symposium on Helminthiases.

Except for phenothiazine, even these primary antihelminthics are limited. "None is ideal." Phenothiazine combines a wide and unique range of application, high degree of efficiency, unusual margin of safety, ease and versatility of administration, and a variety of antiparasitic action not found in any other antihelminthic. It must be recognized as the outstanding veterinary antihelminthic; unfortunately, it is comparatively expensive, therapeutic doses are bulky, and somewhat toxic.

Treated animals eliminate phenothiazine breakdown products as a red dye in the urine and feces. Although harmless, the dye stains sheep's wool, and is most useful in that animal. However, dairy animal milk is also discolored, resulting in additional economic losses.

Although cattle account for almost two thirds of the livestock industry, there are scarcely a half-dozen chemotherapeutic agents that merit consideration for use against their worm parasites, says Foster. Sheep, which account for less than 4% of the industry, have at least twice this number of drugs.

Besides phenothiazine, hexachloroethane and lead arsenate are used as primary antihelminthics for cattle. About 39 different worm parasites are of more or less economic significance to this host, and less than half are treatable with present antihelminthics.

Absolute economic loss in cattle due to helminthiases is about the same for sheep; estimated at $40 million annually, reports Foster. Over-all loss from swine parasites, almost all due to helminthitic parasites, is estimated at more than $200 million per year. There are only some 18 important classes of worm parasites of swine. "No other animal suffers so much from so few kinds of worms." Only seven antihelminthics are effective against swine parasites, and they are not applicable to all the different worms. No medication can be recommended against some 11 of the 18 comparatively important species.

Proportionately, helminthic losses in sheep and goats are higher than in any other class of livestock. Phenothiazine has permitted the resumption of sheep production in several areas, but there are still large and persistent losses. No treatments are available for 18 important helminths of sheep and goats.

Poultry loss due to helminthiases is pegged at $5 million annually, with no treatment for about 40 worms.