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Book reviews

Sugar Chemistry, by ROBERT S. SHALLENBERGER AND GORDON G. BIRCH, The Avi Publishing Co., 1975, 205 pages, $21.00.

This, in many ways, is an unusual book. Its authors state in the preface that it is intended primarily for persons who are interested in sugar chemistry from the aspect of the use of sugar as food. It covers a very diverse range of material. The first four chapters (of a total of eight), which compose almost half of the book, are concerned with the chemistry of carbohydrates. Then there are chapters on the nutritional and metabolic aspects of sugars, the role of sugars in food and medicine, nonenzymic browning reactions, enzymic hydrolysis of oligosaccharides, and fermentation. As might be expected, the authors have some difficulty covering such a diversity of subjects in a book of 205 pages.

By far the strongest feature of the book, in this reviewer's estimation, is the first four chapters on sugar chemistry. The approach is based very firmly on the stereochemistry of the sugars with an emphasis on conformation. It is precisely this area that is skimped in textbooks on biochemistry and in other texts concerned with the application of sugar chemistry to biological systems. These four chapters could well be made required reading for all students in biochemistry and, for that matter, for all present and would-be authors of biochemistry texts. An examination of recent American text-books of biochemistry, even those of the first rank, soon discloses many gross errors in stereochemistry. This is no small matter when one considers that the major controlling factor in enzymic catalysis is the shape of the substrate molecule. Confusion on the matter of molecular shape is thus something that biochemists should try to minimize. A perusal of the first four chapters of this book will do a great deal toward achieving this end.

I am not nearly so happy with some of the other chapters in the book. The one on nutritional and metabolic aspects of sugars begins with a discussion of the modern view of the relation between structure and sweetness in sugars and other substances. This is certainly worthwhile, since it is thoroughly done and the reviewer is not aware of the same ground being covered, other than in a passing fashion, in any other text book. However, the material on this subject occurs in two different places in the book, a section of 13 pages at the beginning of this chapter and a section of about 8 pages in a later chapter (the role of sugars in food and medicine). It would have been much better if all of this material had been put in one place. The rest of this chapter consists of short sections concerned with the digestion of carbohydrates, rare food-sugars, glucose syrup, malabsorption and other ill effects, carbohydrate metabolism, and nucleosides, nucleotides, and nucleic acids. The space allotted simply prevents justice being done to any of these subjects; the selection of subheadings seems to follow no

plan and is very scattered. For instance, under "metabolism of carbohydrate" there is a paragraph on "athletic nutrition"(?). This consists of a number of statements concerning the nutrition of athletes that appear to be anecdotal and for which no documentation is given. In the beginning of the section on metabolism of carbohydrate, the authors feel compelled to discuss two of the major metabolic pathways, the Embden–Meyerhof–Parnas (EMP) pathway and the Krebs tricarboxylic acid cycle. The Embden–Meyerhof–Parnas pathway is discussed again in the last chapter of the book. The discussion is very cursory and at the same time has many serious errors. It is difficult to determine whether these errors are due to loose use of English or are caused by the authors' failing to base their discussion solidly on the organic chemistry that constitutes the two metabolic pathways. The impression is given that lactate is decarboxylated to acetaldehyde and reduced to ethanol! It is stated that the metabolism of fatty acids proceeds by way of pyruvate, which is incorrect. It is said that the cycle is completed by the conversion of malic acid into citric acid through the "intermediation" of coenzyme A; this also is not correct. Both pathways are referred to as cycles; this is not true in the case of the EMP pathway. Both pathways are said to be freely reversible and this results in fatty acid being converted into carbohydrate. Both statements are in error. One detects similar mistakes in the discussion of the more physiological aspects of the subject. For instance, in the discussion on blood D-glucose, the authors give the impression that dietary carbohydrate goes directly into the general blood circulation; they appear to be unaware of the hepatic portal system and its importance in carbohydrate absorption.

In the next chapter, "The Role of Sugars in Food and Medicine", some of the material is either a repetition or an enlargement of that presented in the previous chapter. The matter of further discussion of the sweetness of sugar has already been mentioned and there is further discussion on the absorption of sugar and the role of blood sugar and dietary fiber. This does nothing for the coherence of the material presented in the book.

The chapter on nonenzymic browning reactions (Chapter 7) appears to the reviewer to be well done. Here, the authors pay considerable attention to the chemistry involved, and carry on the discussion on this basis. It is evident that they have great competence in the field. However, in the last chapter, on the enzymic hydrolysis of oligosaccharides and fermentation, the performance slips back again. Their discussion of the enzymic hydrolysis of oligosaccharides is far too cursory to do justice to the subject. The discussion on the metabolic basis of fermentation repeats to some degree the discussion in Chapter 5 and again there are significant errors. The authors do not mention that there are many important fermentative processes other than the alcohol and lactate fermentations. From the discussion of alcoholic fermentation, an uninitiated reader would assume that yeast can carry out the lactate fermentation, which is not the case. Further, both the text and the accompanying diagram give the impression that D-galactose enters the EMP pathway by direct isomerization of D-galactosyl phosphate to D-glucosyl phosphate. This may well have been done to simplify the details of the rather complex process whereby D-galactose is converted

into D-glucosyl phosphate, but the failure to comment on the simplification, and its presentation in the diagram as being completely analogous to the conversion of D-mannose 6-phosphate into D-glucose 6-phosphate, certainly give the uninitiated reader (the important reader in the case of this book) an erroneous impression.

In summary, the reviewer is very favorably impressed with the first four chapters of this book but feels that three of the last four chapters are presented in such a cursory and disjointed fashion that they mar the rest of the book.

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Edible Starches and Starch-Derived Syrups, by N. B. PETERSEN, Noyes Data Corporation, Park Ridge, New Jersey 07656, 1975, v+427 pages, $36.00.

Processed-food and beverage industries (such as baking, confectionery, brewing, and canning) consume huge quantities of modified starches and starch-derived sugars [dextrose (D-glucose), fructose–dextrose syrups, and glucose syrups of various molecular-weight distributions]. A highly specialized technology exists for the chemical, enzymic and physical modification of starches into forms that fulfil the functional needs of the myriad types of processed foods and beverages. All must conform to specified food-acceptability requirements. For edible starches, the transformations are largely those affecting the viscosity and solubility in water. More-extensive transformations involve combinations of acid and enzymic hydrolyses to prescribed levels of reducing power; essentially complete hydrolysis to dextrose; and the recently developed isomerization of dextrose to a mixture of D-fructose and dextrose (D-glucose).

Rarely does a single starch-product have universal applicability. Consequently, an unusually large number of food starches are on the market, each designed to fit the requirements of a specific food product. For example, the rheology (flow) and clarity of a pie starch-additive are quite different from those of a starch used in the canning of cream-style corn. On the other hand, the starch syrups are fewer in number, and are generally classified according to their reducing power (expressed as dextrose). Thus, the fermentability requirements of a brewer and the hygroscopicity requirements of a candy manufacturer can be fulfilled by mixing syrups from a relatively small range of products. The sweetness and flavor requirements of the soft-drink industry are met by fructose–glucose syrups.

It is not surprising, therefore, that the patent literature on edible starches and starch-derived syrups is large. A periodic collation of this literature is always welcome. The Noyes' "Food Technology Review No. 24," covers the U.S. patents since 1968. The technology is international, however, as evidenced by the patents assigned to

non-American companies and individuals. The patents are arranged according to product-type, with the Table of Contents serving as a general subject index (in the absence of a detailed Subject Index). Each subject is prefaced by a brief introduction that defines the area and the terms used in the patents.

The subject areas covered are: isolation of raw starch; treatment of starch (such as removal of lipids and the like); gelatinized starches (processes and end-uses); starch esters and ethers; amylose and amylopectin; partially hydrolyzed (acid and enzyme) starch products; starch syrups; dextrose; maltose and lower oligosaccharides; and the more recent, starch-based fructose syrups. Understandably, it is not likely that all of the technology described is actually being practised, a point that should have been stressed in the introduction. A more serious fault is the lack of indication that some of the starches and syrups disclosed in the patents have not been approved by the Food and Drug Administration (FDA) for food use, and cannot be considered "edible". Likewise, processes utilizing new reagents for certain derivatized starches (FDA-approved within prescribed process and composition limits) have not been approved. Despite these shortcomings, the review presents a wealth of information on current starch technology, and accents the many disciplines utilized in its practice. It should be most useful to starch and food chemists.

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