

高路 编著

粮油食品专业英汉双语

BILINGUAL ENGLISH-CHINESE TEACHING BOOK



白山出版社

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地 址: 沈阳市沈河区二纬路 23 号

邮 编: 110013

电 话: 024-23088689

电子信箱: baishan867@163.com

责任编辑: 王婧媛

封面设计: 王 婷

装帧设计: 刘志勇

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前 言

本书是为贯彻教育部关于“本科教育要创造条件使用英语等外语进行公共课和专业课教学……”的文件精神，提高学生国外文献资料的阅读应用能力而编写的双语教材。

这本书从酝酿到成书，经历了一个漫长的过程。从接触食品专业开始，我就对食品专业英语教材的编写萌生了极大的兴趣，因而从那时起就着手准备并收集了大量的第一手资料。粮油食品类专业课、专业英语和基础英语的教学工作又给我编写这本教材提供了得天独厚的条件。借我的课题“粮油食品类英汉双语教学教材开发的研究”获得 2006 年辽宁省大学英语教学改革立项之良机，使得这本书以双语教学教材的形式和大家见面。

本书所选英文素材皆出自近二十年来国内外出版的专业书籍、期刊及网络上的文章，由于渠道繁多，在此恕不一一列举，谨向各位作者表示衷心的感谢。

本书涉及面广，信息量大，选材多样，新颖前沿。可作为高等院校粮油、食品等专业高职学生、本科生、研究生专业课的双语教材，也可供从事与粮油食品相关工作的科研、生产及教学人员作为专业参考书。

这种类型的教材在目前来讲还属于一种新的尝试，敬请专家学者提出宝贵的意见和建议。

内 容 简 介

在教材内容上，主要选择了有关粮油食品的科技文章，包括食品化学（碳水化合物、蛋白质、脂肪和维生素）、生物化学（酶）、焙烤食品（面包）、粮油食品储藏、啤酒生产、废水处理、机械设备使用说明、论文摘要等专题内容。

本教材共十个单元，每个单元由六个模块组成，包括 Key words（关键词）、Original text（英文原文）、Homologous contents（相应的中文内容）、Link to knowledge（相关知识）、Knowledge accumulating（知识积累）、Comprehensive ability（综合能力）。

每个单元开始部分的 Key words 模块附有本单元要求掌握的基本词汇，以关键词的形式加以体现；Original text 主模块安排了多种文体，并附有疑难句解析和经典例句；Homologous contents 模块根据英文内容，结合中文教材给出相应的中文部分，它不是逐字逐句的生硬翻译，而是以保证知识点为目标；Link to knowledge 模块是 Original text 主模块的延伸阅读，是主模块内容的补充和拓展；Knowledge accumulating 模块根据主模块内容对相关的专业术语进行了归纳总结，如糖类日常术语、食品质量营养及卫生术语、食品材料术语、面粉类专业术语、食品添加剂与食用香料术语、食品机械术语等；Comprehensive ability 模块旨在培养学生的专业英语综合能力，主要包括英汉句式特点、被动句的翻译、英语数字的翻译、标题的写法、摘要的写作及互译、机械设备使用说明及产品说明书的编写等内容。

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Unit One Carbohydrates



Key words

carbohydrates 碳水化合物, polyhydroxy 多羟基, aldoses 醛糖, aldehyde 醛, ketone 酮, ketoses 酮糖, hemiacetal 半缩醛, corn syrup 淀粉糖浆, 葡萄糖浆, cornstarch 玉米淀粉, corn sugar 葡萄糖, pentoses 戊糖, pentosan 戊聚糖, hexoses 己糖, levulose 左旋糖, 果糖, monosaccharide (=glycose) 单糖, disaccharide 双糖, oligo-and-polysaccharides 低聚糖-多聚糖, fructan 果聚糖, oligo- 少, 缺乏, [专]寡, 低, glucan(=glucosan) 葡聚糖, glycosides 糖苷, 配糖物



Original text

The food scientist has a many-sided interest in carbohydrates. He is concerned with their amounts in various foods, availability (nutritional and economic), methods of extraction and analysis, commercial forms and purity, nutritional value, physiological effects, and functional properties in foods. Understanding their functional properties in processed foods requires not only knowledge of the physical and chemical properties of isolated carbohydrates, but also knowledge of the reactions and interactions that occur in situ between carbohydrates and other food constituents and the effects of these changes upon food quality and acceptance. This is a tall order for knowledge. Because processing affects both nutritional and esthetic values of food, knowledge of the changes that carbohydrates undergo during milling, cooking, dehydration, freezing, and storage is especially important.

Students are advised to study the fundamental chemistry underlying useful carbohydrates properties of service will be an understanding of

the association of polar molecules through hydrogen bonding, ionic effects, substituent effects, and chelation with inorganic ions, complexing with lipids and proteins, and decomposition reaction. This background will provide an understanding of properties that affect the texture and acceptance of processed foods (e.g., solubility, hygroscopicity, diffusion, osmosis, viscosity, plastity, and flavor production), properties that enable the formation of high quality pastries, gels, coatings, confections, and reconstitutible dehydrated and frozen foods.

Ability to predict what changes in functional properties are likely to ensue from incorporating various types of carbohydrates into processed foods is a practical goal of the food scientist. Such forecasting requires either a wealth of experience with trial-and-error methods or a deep knowledge of carbohydrate properties as related to structure—perhaps both. However, scientific knowledge of cause and effect is highly respected when it shortens industrial development time.

Source, types and terminology

The layman's conception of carbohydrates generally involves only the sugars and starches of foods—those that generate calories and fat. The food chemist knows many other types that are ingested.

Because most people enjoy the sweetness of sugars and the mouth feel of cooked starches, they become familiar by association with table sugar (sucrose), invert sugar's hydrolyzed sucrose, corn syrup sugars (D-glucose and maltose), milk sugar (lactose), and the more starchy foods. These carbohydrates are nutritionally available; i.e., they are digested (hydrolyzed to component monosaccharides) and utilized by the human body. Carbohydrates of dietary fiber (cellulose, hemicellulose, pentosans and pectic substances), in contrast, tend to be overlooked because they are largely unavailable. Digestive enzymes do not hydrolyze them significantly; nevertheless, they may be quite important for human health.

The carbohydrates of natural and processed foods are divided into available and unavailable types. The available carbohydrates vary in degrees of absorption and utilization depending upon quantities ingested, accompanying food types, and human differences in complements of defective enzymes and intestinal transport mechanisms. Malabsorption difficulties and adverse physiological effects are known for all the available carbohydrates but gelatinized starches give little or no trouble.

It is important to realize that in ruminants the unavailable and the most abundant polysaccharide cellulose is partially hydrolyzed to the same highly available sugar that starch provides upon digestion; i. e. D-glucose. Grazing animals do it through the celluloses generated by the microorganisms of their rumen. Cellulose is, therefore, a contributing source of voluble animal protein. Food chemists probably can improve upon the efficiency and economics of the ruminant's conversion of cellulose to nutrients. Development of celluloses that are stable outside the cells of microorganisms enables the culturing of fungi and with yeasts on cellulose hydrolyzates. Fungi (e. g., mushrooms) can produce protein with the biological value of animal protein. The conversion of cellulose wastes to animal feed and human food is an intriguing prospect for limiting environmental pollution and for feeding the world's expending population.

Carbohydrates were first named according to their natural sources; e. g., beet sugar, cane sugar, grape sugar, malt sugar, milk sugar, cornstarch, liver glycogen, and sweet corn glycogen. Trivial names were then formed, in English terminology, often from a prefix related to the source followed by the suffix "-ose" to denote carbohydrate. Names arising in this way, for example, are fructose, maltose, lactose, xylose, and cellulose. These short, well-established names are still commonly used. They furnish no information on the chemical structures however, so a definitive carbohydrate nomenclature has been developed. From the definitive names, structural formulas can be written. Some of the terms

involved in the definitive nomenclature are explained in the following paragraphs.

The simple sugars (monosaccharides) are basically aliphatic polyhydroxy aldehydes and ketones: $\text{HOCH}_2-(\text{CHOH})_n-\text{CHO}$ and $\text{HOCH}_2-(\text{CHOH})_{n-1}-\text{C}=\text{O}-\text{CH}_2\text{OH}$ called "aldoses" and "ketoses" respectively. However, it must be understood that cyclic hemiacetals of those open-chain forms prevail in solids and at equilibrium in solutions. In the definitive nomenclature, the suffix "ose" is appended to prefixes denoting the number of carbon atoms in the monosaccharide; e.g. trioses ($n=3$), tetroses ($n=4$), pentoses ($n=5$), hexoses ($n=6$) to distinguish aldoses from ketoses, ketoses are designated as "-uloses." Thus, the simplest ketose, $\text{HOCH}_2-\text{C}=\text{O}-\text{CH}_2\text{OH}$, is a triulose; the most common ketose, D-fructose (levulose), is a hexulose. To designate the configurations of hydroxyl groups on the asymmetric carbon atoms of monosaccharides, the prefixes D and L are used together with prefixes derived from the trivial sugar names (e.g., D-glycero-, L-arabino-, D-xylo-) followed by pentose, hexose hexulose, etc.

As open-chain hydroxy aldehydes and hydroxyl ketenes, the monosaccharides are very reactive. They readily enolize in alkaline solutions to reduce ions such as Cu^{2+} and $\text{Fe}(\text{CN})_6^{3-}$. Therefore, they are called "reducing sugars". Plants protect the reactive monosaccharides for transport and storage by condensing them with loss of water, into less reactive sugars, e.g., D-glucose and D-fructose, are condensing in such a way that their reactive functions are lost to form the disaccharide non-reducing sugar, sucrose. The less reactive sucrose is then transported to all parts of the plant for enzymic syntheses of oligo- and polysaccharides. From thousands or more D-glucose moieties of sucrose the glucans, starch and cellulose, are built. From the D-fructose moiety of sucrose, fructans such as inulin are assembled. Other polysaccharides are formed from other sugar, which arise by enzymic transformations of phosphorylated hexoses and sugar nucleotides.

The prefix "glyc" is used in a generic sense to designate sugars and their derivatives; e.g., glycoses, glycosides, glycosans, glyconic glyceric and glycuronic acids. The generic name for polysaccharides is "glycan". Homoglycans are composed of single monosaccharide; for example, the D-glucans, cellulose and starch, release only D-glucose by hydrolysis. Other homoglycans (e.g., the hexosans, D-galactan and D-mannan, and the pentosans, L-arabinan and D-xylan) are uncommon in nature. Heteroglycans are composed of two or more different monosaccharides, are widely distributed, and the homoglycans that are not glucans. Galactomannans, glucomannans, arabinogalactans and arabinoxylans are common heteroglycans (composed of two sugars). The glycanic veil over free glycoses in natural foods.

The reducing sugars are readily oxidized. Mild oxidation of aldoses yields aldonic acids, $\text{HOCH}_2-(\text{CHOH})_n-\text{COOH}$; e.g., gluconic acid ($n=4$). Oxidation of both ends of the aldose molecule yields aldonic acids, $\text{HOOC}-(\text{CHOH})_n-\text{COOH}$; e.g., tartaric acid ($n=2$). Oxidation of the terminal CH_2OH group of hexoses without oxidation of the reducing function (protected) produces hexuronic acids, $\text{HOOC}-(\text{CHOH})-\text{CHO}$. The hexuronic acids are common monosaccharide constituents of many heteroglycans. For example, they are found in acidic hemicelluloses, pectic substances, alginates and exudate gums, and the mucopolysaccharides of mammalian tissues. Penturonic acids have not been found in nature.

Reduction of aldoses or ketoses yield sugar alcohols, properly called "alditols", $\text{HOCH}_2-(\text{CHOH})_n-\text{CH}_2\text{OH}$. The suffix "-itol" is applied to the trivial prefixes to denote different alditols; e.g., D-glucitol, D-mannitol, xylitol. The triitol, glyceritol (by common usage, glycerol, $n=1$), is the alditol moiety of fats. Glycerol and D-glucitol (sorbitol) are acceptable and useful food additives for water. Pentitols ($n=3$) and hexitols ($n=4$) are found in small amount in many fruits, vegetables and hexitol, perseitol ($n=5$), and an octitol have been isolated from avocados. Some alditols are nutritionally available; others are not.

Other types of carbohydrates found in food are the condensed N-acetylated amino sugars of mucopolysaccharides, glycoproteins, and chitin; the condense deoxy sugars of gum, mucilages, and nucleotides; glucosides (sugars condensed with nonsugars); glucosinolates (toxic thioglycosides); cyclitols (myoinositol, phytic acid); and reductone, L-ascorbic acid.

Complex carbohydrates, such as cellulose and hemicelluloses, are largely indigestible, as are a number of origins.

Carbohydrate composition of foods

Detains need more exact information on the carbohydrate compassion of foods. Food pressers also make practical use of carbohydrate composition data. For example, the reducing sugar content of fruits and vegetables that are to be dehydrated or processed with heat is frequently an indicator of the extent of nonenzymic browning that can expected during processing and storage. The possible hydrolysis of sucrose to reduce sugars during processing also is to be considered. The natural changes in carbohydrate composition that occur during maturation and post harvest ripening of plant foods is therefore of particular interest to food chemists.

Citrus fruits, which normally ripen on the tree and contain no starch, undergo little change in carbohydrate composition following harvest. However, fruits are picked before complete ripening (e.g., apples, bananas, pears); much of the stored starch is converted to sugars as ripening process. The reducing sugar content of potatoes also increase during the sun drying of grapes and dates, sucrose is converted to D-glucose and D-fructose; accordingly, the color of the dried products is deepened by nonenzymic browning reactions.

Green peas, green beans and sweet corn are picked before maturity to obtain succulent textures and sweetness. Later the sugars would be converted to polysaccharides, water would be lost, and tough textures would develop. In soybean, which is allowed to mature completely before

harvest, the starch reserve is depleted as sucrose and galactosyl sucroses (raffinose, stachyose, verbascose, etc.) are formed in the malting of cereal grains, rapid conversions of reserve carbohydrate to sugars occur as enzymes are strongly activated.

In foods of animal origin, postmortem activity of enzymes must be considered when carbohydrate composition data is obtained. The glycogen of animal tissues, especially liver is rapidly depolymerized to D-glucose after slaughter, and immediate deep freezing is required to preserve the glycogen. Mammalian internal organs, such as liver, kidney, and brains also eggs and shellfish, provide small amount of D-glucose in the diet. Red fresh meats contain only traces of available carbohydrate (D-glucose, D-fructose, and D-ribose) and these are extracted into bouillons and broths. Dairy products provide the main source of mammalian carbohydrate. Whole cow's milk contains about 4.9% carbohydrates and dried skim milk contains over 50% lactose.

Examination of food composition tables shows that in general, cereals are highest in starch content and lowest in sugars. Fruits are the highest in free sugars and the lowest in starch. On a dry basis, the edible portions of fruit usually contain 80-90% carbohydrate. Legumes occupy intermediate portion with regard to starch and are high in unavailable carbohydrate.

Glycosides of many types are widely distributed in plants. Certain biologically active thioglucosides, properly called "glucosinolates", are found in significant amount in crucifers. Mustard oils, nitriles, and goitrins are released by enzymic hydrolysis. Their suspected goitrogenic in humans have been investigated, but the amount of glucosinolates normally consumed in food such as fresh cabbage (300-1000ppm), cauliflower, Brussels sprouts, turnip, rutabagas, and radishes are not now believed to cause adverse physiological effects. Cyanogenic glycosides, which release hydrogen cyanide by enzymic hydrolysis under certain condition of vegetable maceration, are known to be sources of acute toxicity in certain animal feeds; however they

are not active in the customary foods of developed countries. Certain foreign varieties of lima beans and manioc root (cassava) may yield up to 0.3% hydrogen cyanide by weight, but lima beans distributed in the United States yield less than 0.02%. Saponins, the surface-active glycosides of steroids and triterpenoids, are found in low concentrations in tea leaves, spinach, asparagus, beets, sugar beet (0.3%), yams, soybeans (0.5%), alfalfa (2-3%), peanuts and other legumes.



Homologous contents

碳水化合物

一、糖的化学概念

糖是自然界存在的一大类有机化合物。它是由绿色植物经光合作用形成的。这类物质主要是由碳、氢和氧三种元素组成，其分子通式以 $C_n(H_2O)_m$ 表示。由于一般糖分子中氢和氧原子数之比往往是 2:1，刚好与水分子中氢、氧原子数的比例相同，过去误认为此类物质是碳与水的化合物，故有碳水化合物 (carbohydrate) 之称。但事实上不可能将碳与水化合成“碳水化合物”；同时有些糖，如鼠李糖 ($C_6H_{12}O_5$) 和脱氧核糖 ($C_5H_{10}O_4$) 等，它们分子中的氢、氧原子数之比并非 2:1；相反，一些非糖物质如甲醛 (CH_2O)、乳酸 ($C_3H_6O_3$)、乙酸 ($C_2H_4O_2$) 等，它们分子中的氢、氧原子数之比却都是 2:1。所以，把糖类称“碳水化合物”并不恰当。但由于沿用已久，习惯上人们仍把糖类称为“碳水化合物”。

糖类是多羟基醛或多羟基酮及其衍生物。例如常见的葡萄糖 (glucose) 是己醛糖、果糖 (fructose) 是己酮糖。

二、糖类的重要性

糖类广泛存在于生物体中，是构成生物体的重要成分。粮食中 70% 以上的干物质是糖类。粮食中的糖类主要包括淀粉、纤维素、葡萄糖、蔗糖、果胶质 (pectic substances) 等。

粮食中的糖类对人类营养、粮食的食用品质及粮食贮藏特性等方面有着重要的实践意义。如淀粉，它是人类维持生命活动重要的能量来源，而且淀粉的组成和性质是决定粮食食用品质及工艺品质的重要因素，如粮食之所以为糯性和非糯性、绿豆为什么适于制粉丝，都是由于淀粉的组成和性质的不同所决定

的。再如可溶性糖类，在粮食中主要是葡萄糖及蔗糖，它们是人类的营养物质，而且它们在粮食中数量的变化，可以反映粮食贮藏的稳定性以及粮食食用品质、工艺品质是否合乎要求。纤维素和半纤维素不能被人类消化吸收，对人类无营养价值，但可以刺激肠胃，促进食物流动，有利于其它营养物质的吸收利用，所以也是人类食品必须成分之一。此外，许多糖类，可被微生物利用进行发酵。对于食品工业及粮食副产品的综合利用有着重要的意义。

三、糖的分类

糖类根据它们的水解情况分成单糖、低聚糖和多糖三类。

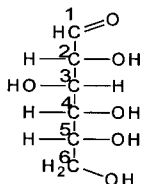
1、单糖

凡不能被水解成更小分子的糖为单糖。单糖又可根据其分子含碳原子数目的多少分类，在自然界分布较广的是五碳糖和六碳糖，它们分别叫做戊糖和己糖。如核糖(ribose)、脱氧核糖(deoxy ribose)是戊糖，葡萄糖、果糖和半乳糖(glactose)都属己糖。

单糖的种类很多，但在结构上和性质上均有共同之处。粮食中的单糖主要是葡萄糖，它是粮食中重要多糖（如淀粉、纤维素等）的基本结构单位。因此，一般以葡萄糖为例来阐述单糖的结构和性质。

(1) 链状结构及构型

根据葡萄糖的成分分析和分子量测定，推断其分子式为 $C_6H_{12}O_6$ 。经实验证明它的链状结构式是：



葡萄糖是己醛糖。醛糖碳原子的定位是，醛基上的碳原子为 C_1 ，依次为 $C_2 \cdots \cdots$ ，直至末端伯醇基上的碳原子。

葡萄糖的构型：葡萄糖有 D-及 L-两种异构体。通常以具有一个不对称碳原子最简单的单糖——甘油醛为标准，进行比较来确定单糖的构型。凡在理论上可由 D-甘油醛(即 D-甘油醛糖)衍生出来的单糖为 D-型糖，由 L-型甘油醛衍生出来的单糖为 L-型糖。天然存在的葡萄糖为 D-型，称为 D(+) 葡萄糖。