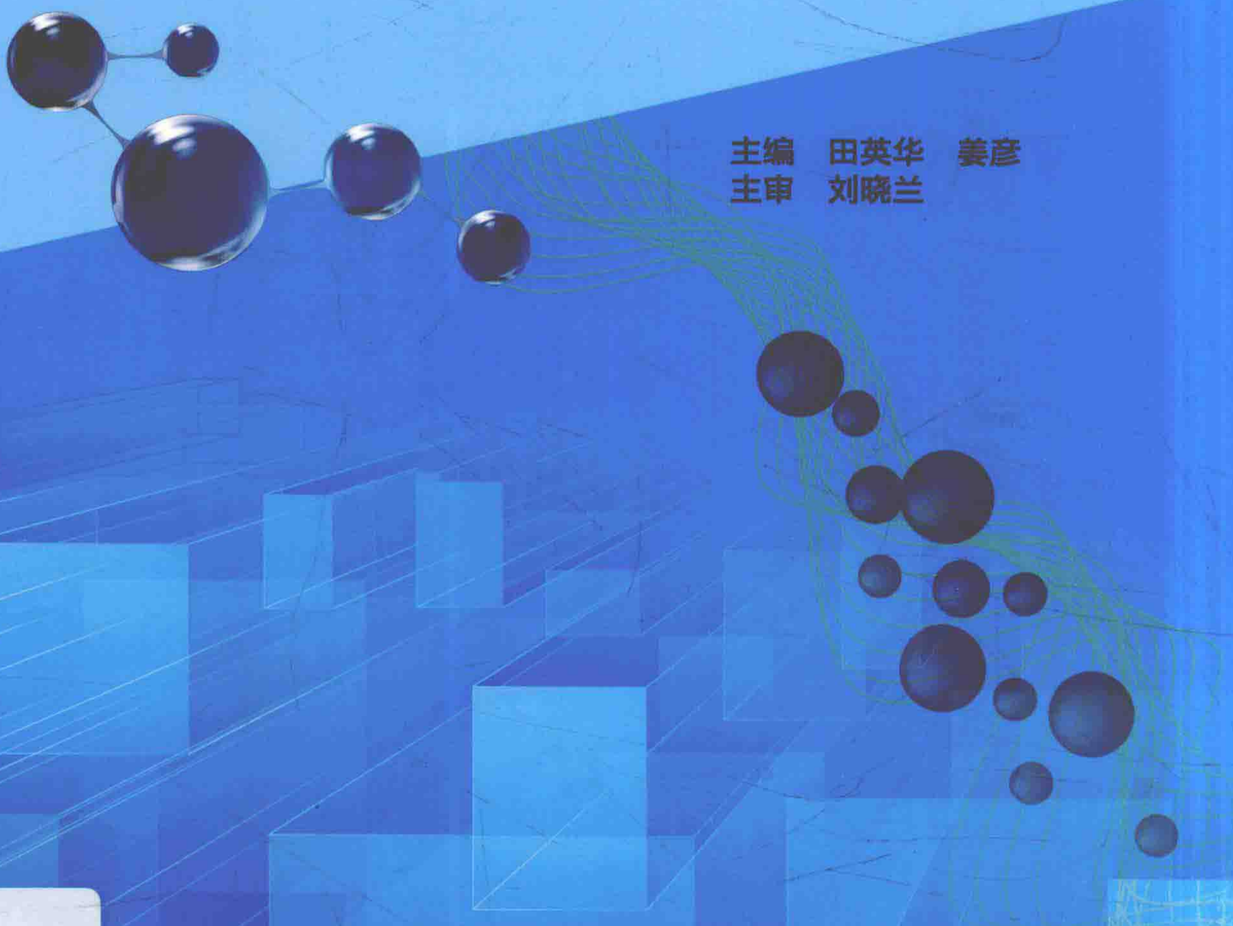
English Course for Bioengineering and Biotechnology

生物工程与生物技术专业英语

主编 田英华 姜彦
主审 刘晓兰



HEUP 哈爾濱工程大學出版社

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内容简介

本书选择了生物工程和生物技术的原理、发展和应用等方面的专业知识，以生物工程学、基因工程、酶学等内容为主，力求使读者能够接触更多的专业词汇、形式多样的文体和更多实用句型。主要内容：第1单元为氨基酸的生产方法、用途和前景，以及各种氨基酸的生产工艺；第2单元为酶学的发展史以及纤维素酶的应用；第3单元为奥地利生物工程的发展史和基因的简介及应用；第4单元为食品生物技术的代表性产品及食品和饲料添加剂的生产；第5单元为固态发酵的原理、特点及固态发酵的应用；第6单元为固定化酶和细胞的原理、方法及固定化酶和细胞的应用；第7单元为生物工程下游技术中的利用反向微团技术提取蛋白质，以及植物细胞培养中次级代谢产物的提取；第8单元为抗体生产的发展、方法、未来趋势及生化工程的研究进展。

本书可作为生物工程及生物技术专业英语教材，也可作为生物工程及生物技术相关人员学习英语的参考书。

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PREFACE

专业英语课程的目的是通过课程的学习与训练,使学生掌握常用专业词汇和科技英语表达方式,以提高对科技英语的阅读理解能力。本教材的编写原则是:有利于学生通过专业知识学习英语;教材精心选取了与生物工程和生物技术相关的科技成果信息和报道,涉及当前经典领域,覆盖面广,主要包括生物工程基础及概论、酶学、基因工程、生物技术、发酵工程及生物化学理论与实验技术等,代表性强,便于学生通过专业知识学习英语,了解当前生物工程发展的状况及趋势;课文难度略难于科普读物,便于学习和讲授。本教材提供了具有专业特色的英语表达形式和科技英语常用句式,有助于学生掌握阅读和翻译专业文献的技巧。

本教材的特点是:均选自英文原版书籍;提高阅读理解能力;包含了科技英语中的主要语法、词与词组;重视词汇;重视写作能力的培养。

本书的各个单元均设有 A,B 两部分,可以根据学生及课程的实际情况讲授全部或部分内容。

本书可作为生物工程及生物技术专业英语教材,也可作为生物工程及生物技术相关人员学习英语的参考书。

本书第 1 至 2 单元由姜彦编写;第 3 至 8 单元由田英华编写,全书由刘晓兰主审。

由于编者水平有限,书中疏漏之处在所难免,敬请专家和广大读者提出宝贵意见。

编　者

2016 年 10 月

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Unit 1

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Amino Acids

1 Introduction

Proteins are **polymers** of amino acids, with each amino acid residue joined to its **neighbor** by a specific type of **covalent bond**. (The term "residue" reflects the loss of the elements of water when one amino acid is joined to another.) Proteins can be broken down (**hydrolyzed**) to their **constituent** amino acids by a variety of methods, and the earliest studies of proteins naturally focused on the free amino acids derived from them. Twenty different amino acids are commonly found in proteins. The first to be discovered was **asparagine**, in 1806. The last of the 20 to be found, **threonine**, was not identified until 1938. All the amino acids have trivial or common names, in some cases **derived from** the source from which they were first isolated. Asparagine was first found in **asparagus**, and **glutamate** in wheat gluten; **tyrosine** was first isolated from cheese (its name is derived from the *Greek tyros*, "cheese"); and **glycine** (*Greek glykos*, "sweet") was so named because of its sweet taste.

Amino Acids Share Common Structural Features

All 20 of the common amino acids are α-amino acids. They have a **carboxyl** group and an amino group bonded to the same carbon **atom** (the α carbon) (Fig. 1.1). They differ from each other in their side chains, or R groups, which vary in structure, size, and electric charge, and which influence the solubility of the amino acids in water. In addition to these 20 amino acids there are many less common ones. Some are residues modified after a protein has been **synthesized**; others are amino acids present in living organisms but not as constituents of proteins. The common amino acids of proteins have been assigned three-letter **abbreviations** and one-letter symbols (Tab. 1.1), which are used as shorthand to indicate the composition and sequence of amino acids polymerized in proteins.

Key Convention: The three-letter code is transparent, the abbreviations generally consisting of the first three letters of the amino acid name. The one-letter code was devised by *Margaret Oakley Dayhoff* (1925—1983), considered by many to be the founder of the field of *bioinformatics*. The one-letter code reflects an attempt to reduce the size of the data files (in an era of punch card computing) used to describe amino acid sequences. It was designed to be easily memorized, and understanding its origin can help students do just that.

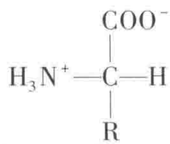

Fig. 1.1 General structure of an amino acid. This structure is common to all but one of the α-amino acids. (Proline, a cyclic amino acid, is the exception.) The R group, or side chain, attached to the α carbon is different in each amino acid.

Tab. 1.1 Properties and Conventions Associated with the Common Amino Acids Found in Proteins

Amino acid	Abbreviation/Amino acid symbol		Mr	pK_a values			pI	Hydropathy index	Occurrence in proteins (%)
				pK_1 (—COOH)	pK_2 ($—NH_3^+$)	pK_R (R group)			
Nonpolar, aliphatic R groups									
Glycine	Gly	G	75	2.34	9.60		5.97	−0.4	7.2
Alanine	Ala	A	89	2.34	9.69		6.01	1.8	7.8
Proline	Pro	P	115	1.99	10.96		6.48	1.6	5.2
Valine	Val	V	117	2.32	9.62		5.97	4.2	6.6
Leucine	Leu	L	131	2.36	9.60		5.98	3.8	9.1
Isoleucine	Ile	I	131	236	9.68		6.02	4.5	5.3
Methionine	Met	M	149	2.28	9.21		5.74	1.9	2.3

Tab. 1. 1 (Continued)

Amino acid	Abbreviation/ Amino acid symbol		Mr	pK_a values			pI	Hydropathy index	Occurrence in proteins (%)
				pK_1 (—COOH)	pK_2 ($—NH_3^+$)	pK_R (R group)			
Aromatic R groups									
Phenylalanine	Phe	F	165	1.83	9.13		5.48	2.8	3.9
Tyrosine	Tyr	Y	181	2.20	9.11	10.07	5.66	-1.3	3.2
Tryptophan	Trp	W	204	2.38	9.39		5.89	-0.9	1.4
Polar, uncharged R groups									
Serine	Ser	S	105	2.21	9.15		5.68	-0.8	6.8
Threonine	Thr	T	119	2.11	9.62		5.87	-0.7	5.9
Cysteine	Cys	C	121	1.96	10.28	8.18	5.07	2.5	1.9
Asparagine	Asn	N	132	2.02	8.80		5.41	-3.5	4.3
Glutamine	Gln	Q	146	2.17	9.13		5.65	-3.5	4.2
Positively charged R groups									
Lysine	Lys	K	146	2.18	8.95	10.53	9.74	-3.9	5.9
Histidine	His	H	155	1.82	9.17	6.00	7.59	-3.2	2.3
Arginine	Arg	R	174	2.17	9.04	12.48	10.76	-4.5	5.1
Negatively charged R groups									
Aspartate	Asp	D	133	1.88	9.60	3.65	2.77	-3.5	5.3
Glutamate	Glu	E	147	2.19	9.67	4.25	3.22	-3.5	6.3

For all the common amino acids except glycine, the α-carbon is bonded to four different groups: a carboxyl group, an amino group, an R group, and a **hydrogen atom** (Fig. 1. 1; in glycine, the R group is another hydrogen atom). The α-carbon atom is thus a **chiral center**. Because of the **tetrahedral** arrangement of the **bonding orbitals** around the α-carbon atom, the four different groups can occupy two unique **spatial** arrangements, and thus amino acids have two possible **stereoisomers**. Since they are **non-superposable** mirror images of each other (Fig. 1.2), the two forms represent a class of stereoisomers called **enantiomers**. All molecules with a chiral center are also **optically active**—that is, they rotate **plane-polarized light**.

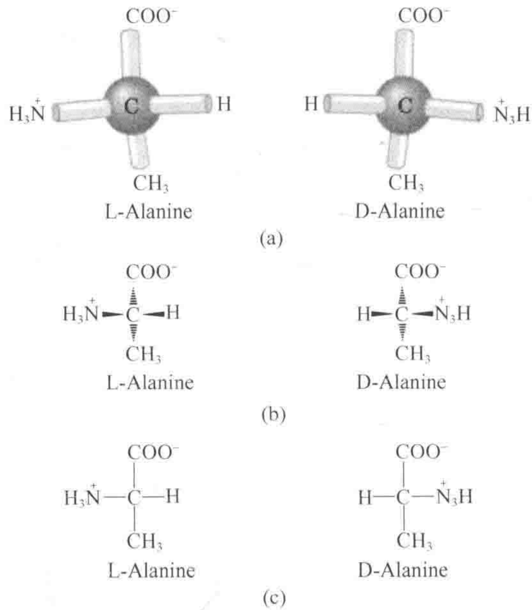

Fig. 1.2 Stereoisomerism in α-amino acids.

(a) The two stereoisomers of alanine, L-and D-alanine are non-superposable mirror images of each other (enantiomers). (b) (c) Two different conventions for showing the configurations in space of stereoisomers. In perspective formulas (b) the solid wedge-shaped bonds project out of the plane of the paper, the dashed bonds behind it. In projection formulas (c) the horizontal bonds are assumed to project out of the plane of the paper, the vertical bonds behind. However projection formulas are often used casually and are not always intended to portray a specific stereochemical configuration.

New Words

amino acid	氨基酸
protein	蛋白质
polymer	聚合物,聚合体,高聚物
neighbor	邻居
covalent bond	共价键
hydrolyze	水解
constituent	构成的,组成的
asparagines	天冬酰胺,天门冬素,氨羰丙氨酸
threonine	苏氨酸,羟丁胺酸
derive from	源出,来自,得自,衍生于
asparagus	芦笋,龙须菜,天冬
glutamate	谷氨酸,谷氨酸盐
tyrosine	酪氨酸
glycine	甘氨酸,氨基乙酸
carboxyl	羧基
atom	原子
synthesize	合成,综合
abbreviation	缩写,缩写词,简称
devise	设计,想出,发明,图谋
bioinformatics	生物信息学,生物信息,生物资讯
hydrogen atom	氢原子
chiral center	手性中心
tetrahedral	四面体的,有四面的
bonding orbital	成键轨函,成键轨道,成键轨函数
spatial	空间的,存在于空间的,受空间条件限制的
stereoisomer	立体异构体
non-superposable	不可叠加的,不可重合的
enantiomer	对映体,对映异构体
optically active	光学活性的,有旋光力的,起偏振作用的
plane-polarized	平面偏振光,平面偏光

2 The Amino Acid Residues in Proteins Are L Stereolsomers

Nearly all biological compounds with a chiral center occur naturally in only one stereoisomeric form, either D or L. The **amino acid residues** in protein **molecules** are **exclusively** L stereoisomers. D-Amino acid residues have been found in only a few, generally small **peptides**, including some peptides of bacterial cell walls and certain peptide **antibiotics**.

It is remarkable that virtually all amino acid residues in proteins are L stereoisomers. When chiral compounds are formed by **ordinary** chemical reactions, the result is a **racemic** mixture of D and L isomers, which are difficult for a chemist to distinguish and separate. But to a living system, D and L isomers are as different as the right hand and the left. The formation of stable, repeating substructures in proteins generally requires that their constituent amino acids be of one **stereochemical** series. Cells are able to specifically synthesize the L isomers of amino acids because the active sites of enzymes are **asymmetric**, causing the reactions they catalyze to be **stereospecific**.

New Words

amino acid residue	氨基酸残基
molecule	分子
exclusively	唯一地，专有地，排外地
peptide	肽
antibiotics	抗生素，抗菌药物
ordinary	普通的，平凡的，平常的
racemic	外消旋的
stereochemical	立体化学的
asymmetric	不对称的，非对称的
stereospecific	立体定向的，立体专一性的

3 Amino Acids Can Be Classified by R Group

Knowledge of the chemical properties of the common amino acids is central to an understanding of **biochemistry**. The topic can be simplified by grouping the amino acids into five main classes based on the properties of their R groups, in particular, their **polarity**, or tendency to **interact with** water at biological pH (near pH 7.0). The polarity of the R groups varies widely, from **nonpolar** and **hydrophobic** (water-insoluble) to highly **polar** and hydrophilic (water-soluble).

The structures of the 20 common amino acids are shown in Fig. 1. 3, and some of their properties are listed in Tab. 1. 1. Within each class there are gradations of polarity, size, and shape of the R groups.

Nonpolar, Aliphatic R Groups

The R groups in this class of amino acids are nonpolar and hydrophobic. The side chains of alanine, valine, leucine, and isoleucine tend to cluster together within proteins, stabilizing protein structure by means of hydrophobic interactions. Glycine has the simplest structure. Although it is most easily grouped with the nonpolar amino acids, its very small side chain makes no real contribution to hydrophobic interactions. Methionine, one of the two sulfur-containing amino acids, has a nonpolar thioether group in its side chain. Proline has an aliphatic side chain with a distinctive cyclic structure. The secondary amino (imino) group of proline residues is held in a rigid conformation that reduces the structural flexibility of polypeptide regions containing proline.

Aromatic R Groups Phenylalanine, Tyrosine, and Tryptophan, with their aromatic side chains, are relatively nonpolar (hydrophobic). All can participate in hydrophobic interactions. The hydroxyl group of tyrosine can form hydrogen bonds, and it is an important functional group in some enzymes. Tyrosine and tryptophan are significantly more polar than phenylalanine, because of the tyrosine hydroxyl group and the nitrogen of the tryptophan indole ring.

Tryptophan and tyrosine, and to a much lesser extent phenylalanine, absorb ultraviolet light (Fig. 1.4). This accounts for the characteristic strong absorbance of light by most proteins at a wave length of 280 nm, a property exploited by researchers in the characterization of proteins.

Polar, Uncharged R Groups

The R groups of these amino acids are more soluble in water, or more hydrophilic, than those of the nonpolar amino acids, because they contain functional groups that form hydrogen bonds with water. This class of amino acids includes serine, threonine, cysteine, asparagine, and glutamine.

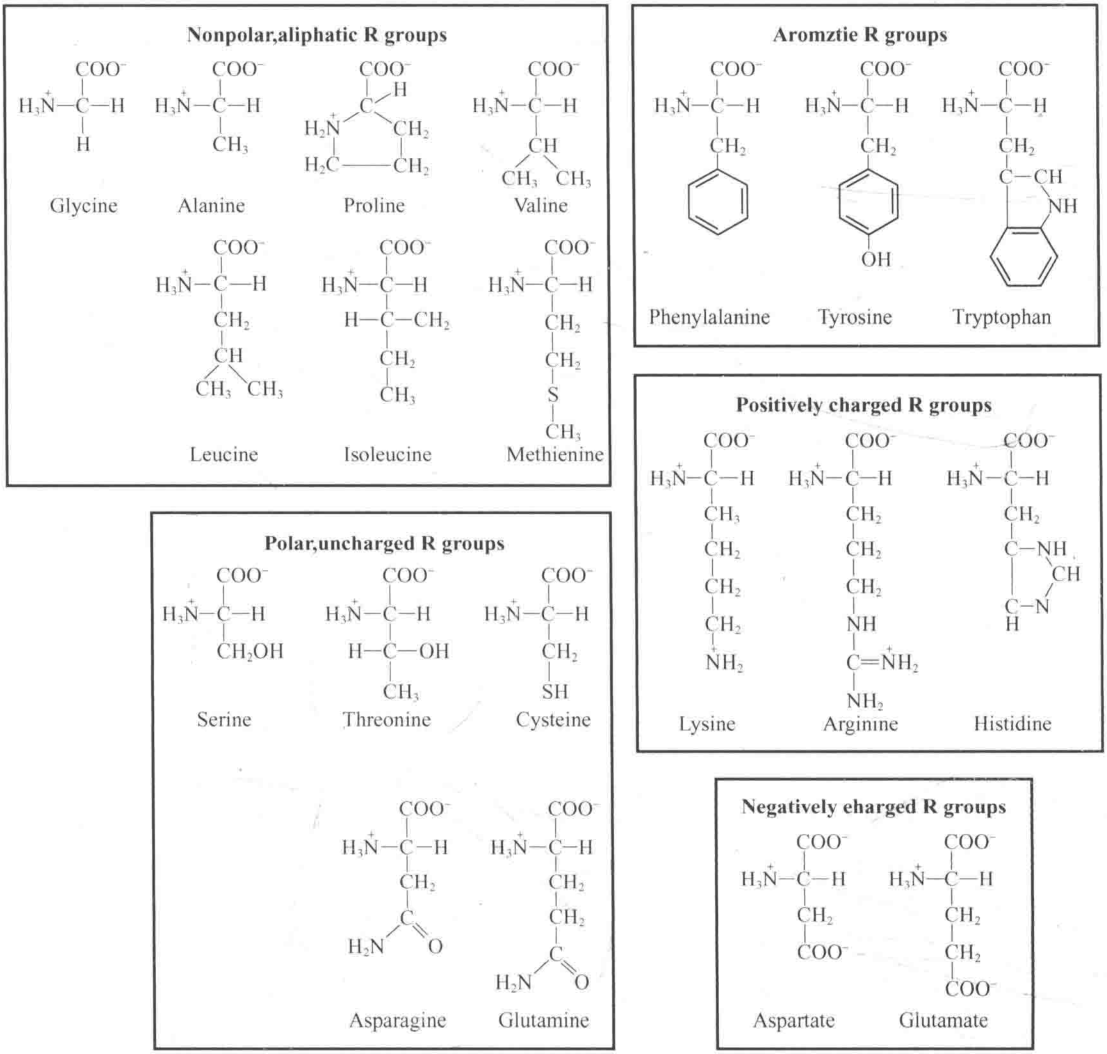

Fig. 1.3 The 20 common amino acids of proteins

The structural formulas show the state of ionization that would predominate at pH 7.0. The unshaded portions are those common to all the amino acids; the portions shaded in pink are the R groups

The polarity of serine and threonine are contributed by their hydroxyl groups; that of cysteine by its sulfhydryl group, which is a weak acid, and can make weak hydrogen bonds with oxygen or nitrogen; and that of asparagines and glutamine by their amide groups.

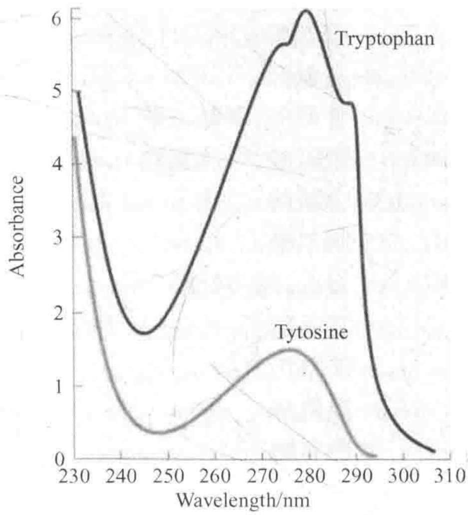

Fig. 1.4 Absorption of ultraviolet light by aromatic amino acid

Positively Charged (Basic) R Groups

The most hydrophilic R groups are those that are either positively or negatively charged. The amino acids in which the R groups have significant positive charge at pH 7.0 are lysine, which has a second primary amino group at the ε position on its aliphatic chain; arginine, which has a positively charged guanidinium group; and histidine, which has an aromatic imidazole group. As the only common amino acid having an ionizable side chain with pK_a near neutrality, histidine may be positively charged (protonated form) or uncharged at pH 7.0. Its residues facilitate many enzymes-catalyzed reactions by serving as proton donors/acceptors.

Negatively Charged (Acidic) R Groups

The two amino acids having R groups with a net negative charge at pH 7.0 are aspartate and glutamate, each of which has a second carboxyl group.

New Words

polarity	极性，两极，对立
hydrophobic	疏水的，狂犬病的，恐水病的
polar	两极的

alanine	丙氨酸
valine	缬氨酸
leucine	亮氨酸
glycine	甘氨酸,氨基乙酸
methionine	蛋氨酸,甲硫氨酸
sulfur-containing	含硫的
proline	脯氨酸
polypeptide	多肽,缩多氨酸
aromatic	芳香的,芬芳的,芳香族的
phenylalanine	苯基丙氨酸
tyrosine	酪氨酸
tryptophan	色氨酸
hydrophobic interaction	疏水作用
hydroxyl group	羟基
hydrogen bond	氢键
indole ring	吲哚环
ultraviolet light	紫外线,紫外辐射,紫外光
sulfhydryl group	巯基
amide group	酰胺基
guanidinium group	胍基
histidine	组氨酸
imidazole group	咪唑,异吡唑
ionizable	可电离的
protonated	质子化的

4 Glutamaic acid

The story of amino acid production started in 1908 when the chemist, Dr K. Ikeda, was working on the **flavouring** components of **kelp**. Kelp is traditionally very popular with the Japanese due to the specific taste of its preparations, kombu and katsuobushi (Fig. 1.5). After acid **hydrolysis** and **fractionation** of kelp, Dr K. Ikeda discovered that one specific fraction he had isolated consisted of **glutamic acid**, which after **neutralization** with **caustic soda**, developed an entirely new, delicious taste. This was the birth of the use of **monosodium glutamate** (**MSG**) as a flavour-enhancing compound, the production of monosodium glutamate was soon commercialized by the Ajinomoto company based on its isolation from vegetable proteins such as **soy** or wheat protein. Since less than 1 kg MSG could be isolated from 10 kg of raw material. The waste fraction was high. The chemical synthesis of D, L-Glutamate, which had been partially successful, was also of little use since the **sodium salt** of the D-**Isomer** is tasteless.

The **breakthrough** in the production of MSG was the isolation of a specific **bacterium** by Dr S. Udaka and Dr S. Kinoshita at Kyowa Hakko kogyo in 1957. They screened for **amino acid**-excreting **microorganisms** and discovered that their isolate, No. 534, had grown on a **mineral salt** medium excreted L-Glutamate. It soon became apparent that the isolated organism needed **biotin** and that L-Glutamate Excretion was triggered by an insufficient supply of biotin. A number of **bacteria** with similar properties were also isolated, which are today all known by the species name **corynebacterium glutamicum** (c. glutamicum for short) (Fig. 1. 6). c. glutamicum is a **gram-positive** bacterium, which can be isolated from soil. Together with genera like **Streptomycetes**, **propionibacterium** or **Arthrobacter**, it belongs to the **actinomycetes** subdivision of gram-positive bacteria. The successful commercialization of MSG production with this bacterium provided a big boost for amino acid production with c. glutamicum and later with other bacteria like **e. coli** as well. **Nucleotide** production for use as **flavour enhancers** also developed rapidly in the 1970s with **c. ammonia genes**, which is closely related to **c. glutamicum**. The production **mutants** and the processed developed also resulted in a demand for sophisticated fermentation devices. Consequently, the development of amino acid technology was an incentive for the fermentation industry in general.

Fig. 1. 5 The ideogram for kombu as it appears on kelp preparation used as a food component

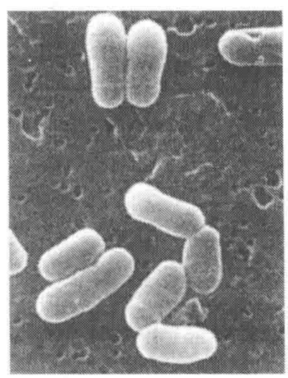

Fig. 1. 6 Electron micrograph of corynebacterium glutamicum showing the typical V-shape of two cells as a consequence of cell division

New Words

flavouring	调味料
kelp	海藻,海藻灰(可提取碘的)
hydrolysis	水解
fractionation	分馏法
glutamic acid	谷氨酸
neutralization	中和
caustic soda	苛性钠
monosodium glutamate (MSG)	味精,味素;谷氨酸一钠(味精的化学成分)
soy	酱油,大豆
sodium salt	钠盐;(专指)氯化钠
isomer	异构体
breakthrough	突破
bacterium (bacteria)	细菌
amino acid	氨基酸
microorganism	微生物,微小动植物
mineral salt	天然盐
biotin	维生素 H,生物素
bacteria	细菌
corynebacterium	棒状杆菌
corynebacterium glutamicum	谷氨酸棒杆菌
gram-positive	革兰氏(染色)阳性
genera	类,属
streptomycete	链霉菌
propionibacterium	丙酸杆菌
arthrobacter	节杆菌属
actinomycete	放射菌类
e. coli	大肠杆菌
nucleotide	核苷
flavour enhancer	香味增强剂,风味增强剂,鲜味增强剂(如味精等)
mutant	突变体