

**DICTIONARY
OF
BIOCHEMISTRY**



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ANMOL PUBLICATIONS
NEW DELHI (INDIA)

Published :

by

ANMOL PUBLICATIONS

4378/B, Gali Murari Lal,

Ansari Road, New Delhi-110002,

Ph. 3261597

ISBN 81-7041-722-2

First Edition 1990

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Printed :

at

Sanjeev Printers, Babarpur, Shahdara Delhi-32.

Preface

The field of biochemistry has become so vast that it becomes difficult to know how far its boundaries have been extending. This dictionary has been an attempt to include terms which have been in common use and introduced recently.

Every attempt has been carefully made to write the entries in a clear and lucid style to provide both straight forward definitions and invaluable background information.

The terms included in this dictionary have been presented in brief analytical phrases thereby avoiding the more comprehensive type of treatment appropriate to large reference work.

The dictionary will be of immense value to the students of biochemistry, medicine, pharmacy, chemistry and others studying or working in related fields.

When a dictionary of this kind is being compiled, it becomes essential to draw upon the work of many authorities and seek the advice of colleagues to all of whom the editors are deeply indebted.

Finally the editors express their sincere thanks to the publishers and printer for printing this book promptly.

All comments from users on omissions or shortcomings will be most welcome.

Editors

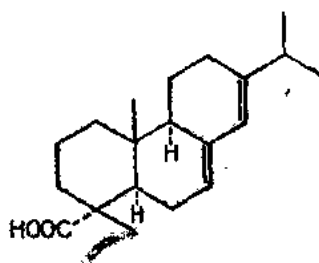
A

A. Abbreviation for adenine.

AAR. Abbreviation for Antigen-antibody reaction (see).

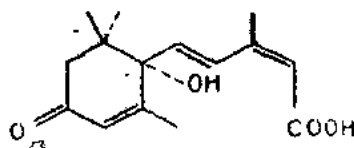
A Band. A transverse dark band, consisting of thick and thin filaments, see in electron microscope preparations of myofibrils from striated muscle.

Abletic Acid. A diterpene carboxylic acid, and the isomeric neoabietic acid, can easily be interconverted. These two resin acids are the main components of rosin (up to 90%), from which they could be obtained by treatment with heat or acids, possibly as products of the rearrangement of other diterpene carboxylic acids. Amber contains derivatives of A.a.



Abietic Acid

Abietic Acid, Abb. ABA, abscisin, dormin: (S)-(+)-5(1'-hydroxy-4'-oxo-2', 6', 6'-trimethyl-2-cyclohexen-1-yl)-3-methyl-cis, trans-2,



(S)-(+)-Absciscic Acid

4-pentadienoic acid. It is a widely occurring, sesquiterpene plant hormone. Its action is mainly inhibitory. It inhibits growth and the germination of seeds. It induces dormancy in seeds and promotes the falling of leaves and fruits. The biosynthesis of ABA is still unknown.

Absolute Oils. See Essential oils.

Acceptor Site. The ribosomal binding site for the aminoacyl-tRNA during protein biosynthesis.

Accumulation of Metabolic Intermediates. See Mutant technique.

Acetaldehyde, Ethanal: $\text{CH}_3\text{-CHO}$. The important intermediate in the degradation of carbohydrates. m.p. -123°C , b.p. 20.1°C . In its activated form (Thiamine pyrophosphate), it gets involved in a number of reactions (Alcoholic fermentation). Two molecules A can undergo acyloin condensation to form Acetoin.

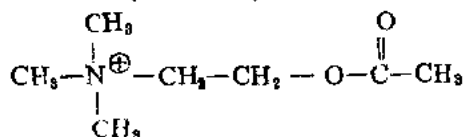
Acetic Acid, Ethanoic Acid: CH_3COOH . A very common monocarboxylic acid which occurs in the free form as the end product of fermentation and oxidation reactions in some organisms. Acetate is formed metabolically by dehydration of acetaldehyde, catalysed either by aldehyde oxidase (EC 1.2.3.1) or a NAD(P)⁺-dependent aldehyde dehydrogenase (EC 1.2.1.3).

Acetoin, 3-hydroxy-2-butanone, Acetyl Methyl Carbinol $\text{CH}_3\text{-CO-CHOH-CH}_3$. A reduction product of diacetyl which arises under certain conditions as a side product of the pyruvate decarboxylase (EC 4.1.1.1) reaction. It is also formed by decarboxylation of acetolactate by acetolactate decarboxylase (EC 4.1.1.5).

Acetylcarnitine. See Carnitine.

Acetylcholine. Refers to a biogenic amine which is biologically highly active. Phylogenetically, it is a very ancient hormone which appears even in protists. It could be a predecessor of the neurohormones.

It acts as a cholinergic neurotransmitter in nerves and neuromuscular synapses; it induces a muscle contraction by changing the permeability of the sarcolemma. It is degraded by acetylcholinesterase (EC 3.1.1.7).



Acetylcholine

Acetylcholinesterase (EC 3.1.1.7). Refers to the "true cholinesterase", which catalyses the hydrolysis of acetylcholine into choline and acetate. This enzyme is found in the central nervous system, particularly in the postsynaptic membranes of the striated muscles, the parasympathetic ganglia, the erythrocytes and the electric organs of fish.

Acetyl-coenzyme A, Acetyl-Co A, Active Acetate $\text{CH}_3\text{CO} \sim \text{SCoA}$. It is a derivative of acetic acid in which the acetyl residue is bound by a high-energy bond to the free SH-group of coenzyme A. The very reactive thioester has a high potential for transfer of the acetyl group, and is therefore a universal intermediate which provides the C_2 fragment for numerous syntheses.

N-Acetylglutamic Acid, N-acetylglutamate, abb. **Ac-glu**, $\text{HOOC}-\text{CH}(\text{NHCOCH}_3)-\text{CH}_2-\text{CH}_2\text{COOH}$. The acetylated form of glutamic acid, is the cofactor of carbamoyl phosphate synthetase (ammonia) (EC 6.3.4.16) and allosterically activates this enzyme.

Acetyl Methyl Carbinol. See Acetoin

Acetyl Phosphate: $\text{CH}_3\text{-COOPO}(\text{OH})_2$. An energy-rich acyl phosphate. It is the product of acetate activation in some organisms: $\text{Acetate} + \text{ATP} = \text{Ap.} + \text{ADP}$; the reaction is catalysed by acetate kinase (EC 2.7.2.1). The back reaction can be used for ATP synthesis, for example in the phosphoroclastic cleavage of pyruvate.

Acid Plants, Ammonium Plants. Plants which accumulate organic acids in their leaf cells, which are neutralized by ammonium ions.

TABLE I
Reactions in which Acetyl-coenzyme A is Synthesized

Enzyme	Reaction	Occurrence/ Significance
Acetyl-CoA synthetase (EC 6.2.1.1)	$\text{CH}_3\text{COO}^- + \text{ATP} + \text{CoA} \rightleftharpoons \text{CH}_3\text{CO-CoA} + \text{AMP} + \text{P}_i$	Yeasts, Animals, Higher plants
Acyl-CoA synthetase (GDP-forming) (EC 6.2.1.10)	$\text{CH}_3\text{COO}^- + \text{GTP} + \text{CoA} \rightleftharpoons \text{CH}_3\text{CO-CoA} + \text{GDP} + \text{P}_i$	Liver

Acetate kinase	$\text{CH}_3\text{COO}^- + \text{ATP} \rightleftharpoons \text{CH}_3\text{CO-O-PO}_3\text{H}_2 + \text{ADP}$ (Acetyl phosphate)	Microorganisms
Phosphate acetyl-transferase (EC 2.3.1.8)	$\text{CH}_3\text{CO-O-PO}_3\text{H}_2 + \text{CoA} \rightleftharpoons \text{CH}_3\text{CO-CoA} + \text{P}_i$	Microorganisms
ATP citrate (pro-3 S)-lyase (EC 4.1.3.8)	$\text{Citrate} + \text{ATP} + \text{CoA} \rightarrow \text{CH}_3\text{CO-CoA} + \text{oxaloacetate} + \text{ADP} + \text{P}_i$	Outside the mitochondria
Pyruvate dehydrogenase complex (EC 1.2.4.1, 2.3.1.12 and 1.6.4.3)	$\text{CH}_3\text{COCO}_2^- + \text{NAD}^+ + \text{CoA} \xrightarrow{\text{TPP, LipS}_2} \text{CH}_3\text{CO-CoA} + \text{CO}_2 + \text{NADH} + \text{H}^+$ (Pyruvate)	Mitochondrial particles
Acetyl-CoA transacetylase (EC 2.3.1.9)	$\text{CH}_3\text{COCH}_2\text{CO-CoA} + \text{CoA} \rightleftharpoons 2\text{CH}_3\text{CO-CoA}$ (Acetoacetyl-CoA)	Fatty acid degradation

Abb. TPP = thiamine pyrophosphate; LipS₂ = Lipoamide

Aconitate Hydratase, Aconitase: (Ec 4.2.1.3). A hydratase which catalyses one stage of the tricarboxylic acid cycle, the reversible interconversion of citrate and isocitrate. The reaction proceeds via the enzyme-bound intermediate, *cis*-aconitate.

Aconitic Acid. An unsaturated tricarboxylic acid, usually occurring in the *cis* form, but sometimes in the *trans*. *cis*-A.a., m.p. 130°C., *trans*-A.a., m.p. 194 to 195°C. The anionic form of *cis*-aconitic acid (propen-*cis*-1, 2, 3-trioic acid) is important as an intermediate in the isomerization of citrate to isocitrate in the Tricarboxylic acid cycle (see).

Aconitine. An Aconitum alkaloid from the roots of aconite (*Aconitum napellus*) and other *Aconitum* and *Delphinium* species, m.p. 197 to 198°C, $[\alpha]_D^{20} = -36^\circ$ (benzene). It is an esterified alkaloid. It is extremely poisonous and can cause death in adults at a dose of to 2 mg by paralyzing the heart and respiration. In spite of useful physiological properties, it is rarely used in medicine, due to its toxicity. It is sometimes used internally as tincture for rheumatism and neuralgias and externally as a pain-killing salve.

Aconitum Alkaloids. A group of terpene alkaloids, some of them very poisonous, from various aconite (*Aconitum*) species. The best-known representative has been aconitine.

ACP. Abb. for acyl carrier protein.

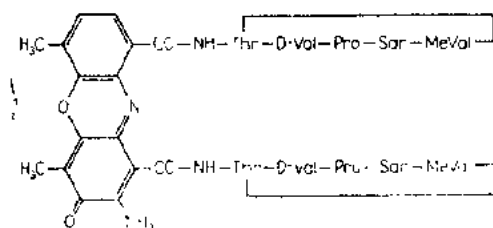
ACTH. Abb. for adrenocorticotrophic hormone.

Actin. See Muscle proteins.

Actinidine. A widely occurring terpene alkaloid.

Actinomycins. Refer to a large group of peptide lactone antibiotics which are produced by various strains of *Streptomyces*. These highly toxic red compounds are having a chromophore, 2-amino-4, 6-dimethyl-3-keto-phenoxazine-1, 9-dioic acid (actinocin), which is linked to two 5-membered peptide lactones by the amino groups of two threonine residues. The various actinomycins differ only in the amino acid sequence of the lactone rings. In vivo, actinomycins inhibit the DNA-dependent RNA synthesis at the level of transcription by interacting with the DNA.

Actinomycin D (Fig.) is one of the most widespread A. Its spatial structure has been elucidated by NMR studies, and the specificity of its interaction with deoxyguanosine was demonstrated by X-ray analysis. Actinomycin D is used as a cytostatic, e.g. in the treatment of Hodgkin's disease.

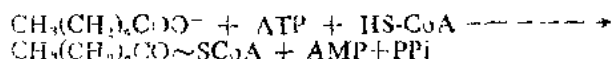


Actinomycin D

Activated Carboxylic Acid. The derivatives of carboxylic acid, which are very reactive, and thus capable of reactions which free acids do not undergo.

Activated Fatty Acids. Fatty acyl coenzyme A thioesters which, as high energy compounds, are having a large potential for group transfer. They are formed during fatty acid biosynthesis, or by

the activation of free fatty acids. Acyl CoA synthetases catalyse formation of the CoA derivatives according to the reaction :



Activated Glycol Aldehyde : 2-(1, 2-dihydroxyethyl)-thiamine pyrophosphate, Abb. DETPP, glycol aldehyde bound to the C-2 atom of the thiazole ring of thiamine pyrophosphate. It is formed in carbohydrate metabolism by cleavage of a ketose and is transferred as C-2 group to an aldose in a transketolation reaction.

Activated Fatty Acids. Derivatives of carboxylic acids which are very reactive, and thus capable of reactions that free acids do not undergo.

Activation Hormone. See Insect hormones.

Activator Protein. See Calmodulin.

Active Acetaldehyde. A-hydroxyethylthiamine pyrophosphate, abb. HETPP, the activated form of acetaldehyde formed by decarboxylation of active pyruvate. The aldehyde is bound to the C-2 atom of the thiazole ring of thiamine pyrophosphate. HETPP is an intermediate in alcoholic fermentation.

Active Center. That part of an enzyme or other protein which binds the specific substrate and converts it to product (enzymes) or otherwise interacts with it (heme proteins, various carrier and receptor proteins).

Active CO₂. See Biotin enzymes.

Active Formaldehyde. See Active one-carbon units; Thiamine pyrophosphate.

Active Formate. See Active one-carbon units.

Active Glycolaldehyde 2-(1, 2-dihydroxyethyl)-thiamine pyrophosphate, abb DETPP, glycolaldehyde bound to C-2 of the thiazole ring of thiamine pyrophosphate. It is formed in carbohydrate metabolism by cleavage of a ketose, and is transferred as a 2 C group to an aldose in a transketolation reaction.

Active One-carbon Units, abb. C₁ Units. C₁ fragments which are activated by binding to tetrahydrofolic acid, or less commonly, to thiamine pyrophosphate. The active ethylenediamine group of tetrahydrofolic acid serves as a carrier for the metabolic transfer of a formyl or methyl or group.

Active Pyruvate. α -lactyl-thiamine pyrophosphate. The lactyl is bound to the C-2 atom of the thiazole ring of the thiamine pyrophosphate. Active pyruvate is an intermediate in the oxidative decarboxylation of pyruvate to acetyl-coenzyme A and in its decarboxylation to acetaldehyde in alcoholic fermentation.

Active Succinate. Refers to the high-energy thioester succinyl-coenzyme A. It is important as an intermediate in the tricarboxylic acid cycle.

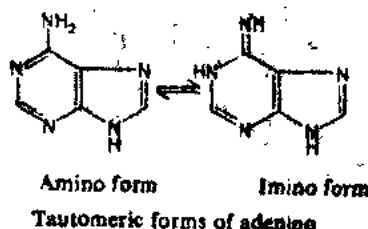
Active Transport. A process in which solute molecules or ions move across a biomembrane from lower to higher concentration, i.e. against the concentration gradient.

Acyl Carrier Protein, abb. ACP. A small, acidic, heat stable globular protein which is part of the fatty-acid synthesizing complex in *Escherichia coli* and other bacteria, yeasts and plants. It is the carrier of the fatty acid chain during its biosynthesis.

Adaptor Hypothesis. A suggestion made by Crick to explain the translation of the genetic code. He proposed that there must be an adaptor between the information-carrying nucleic acid and the protein being synthesized which was able to "recognize" both kinds of molecules. The discovery of tRNA and the corresponding amino acyl-tRNA synthetases confirmed his hypothesis.

Addictive Drugs, Psychotropic Drugs. The drugs which create a sense of euphoria, and which have a strong potential for addiction.

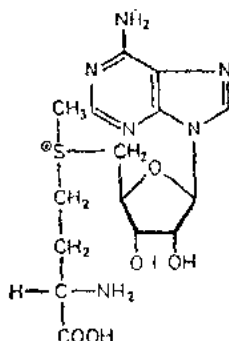
Adenine, abb. A or Ade. 6-aminopurine. It is one of the common nucleic acid bases. It is also part of the adenosine phosphates and other physiologically active substances, including various nucleoside antibiotics. It is synthesized *de novo* from adenosine monophosphate, or is formed by degradation of nucleic acids. Adenine deaminase (EC 3.5.4.2) removes the 6-amino group to give hypoxanthine.



Adenosine, abb. Ado. 9- β -D-ribofuranosyladenine. Phosphorylated derivatives of Ado are metabolically important.

Adenosine Phosphates, Adenine Ribonucleotides. Important as components of nucleic acids and as the major form in which chemical free energy is stored and transferred. They are also important metabolic regulators for example in glycolysis and the tricarboxylic acid cycle. The biologically significant derivatives, including cyclic adenosine 3',5'-monophosphate, carry the phosphate ester on the C-5 of the ribose.

S-Adenosyl-L-methionine, S-(5'-deoxyadenosine-5')-methionine, Active Methionine, Active Methyl. Abb. S-Ado-Met, SAM; a reactive sulfonium compound which is the most important methylating agent in cellular metabolism (see transmethylation). The natural form is the L-(+)-isomer. $[\alpha]_D^{24}$ of $\text{SAM}^+\text{Cl}^- = +48.5$ ($c=1.8$ in 5N HCl). It is formed by activation of L-methionine with ATP: $\text{Met} + \text{ATP} \rightarrow \text{SAM} + \text{PP}_i + \text{P}_i$. The adenosine residue of the ATP is transferred to the methionine.



S-Adenosyl-L-methionine

Adenylate Kinase, Myokinase (EC 2.7.4.3). A trimeric enzyme found in the mitochondria of muscles and other tissues. It is resistant to heat and acid. It catalyses the conversion of two molecules of ADP into ATP + AMP, thus making available the energy of the ADP. At equilibrium, the concentrations of the three adenosine phosphates are nearly equal.

Adenylnucleate, N-succinyladenylate. Abb. [γ - ^{32}P] S-adenosyl-5'-diaz-1,4-N-succinocarboxamide ribonucleotide. Important precursor in purine biosynthesis.

Adenylylsulfate Reductases. Enzymes of sulfur metabolism which reduce either phosphoadenylylsulfate (APS reductase) or adenylylsulfate. Adenylylsulfate reductase, (EC 1.8.99.2) has been identical with one component of the sulfate reductase in sulfate assimilation since adenylylsulfate is the donor of the sulfate group.

Adermine. Vitamin B₆.

ADH. Abb. for Antidiuretic hormone.

Adjuvant. A mixture of oils, emulsifiers, killed bacteria and other components which serves to intensify unspecifically the immune response.

Ado. Abb. for Adenosine.

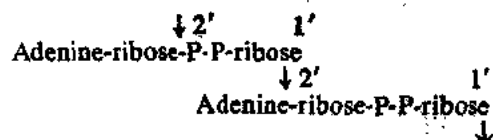
ADP. Abb. for Adenosine 5'-diphosphate.

ADP-ribosylation of Proteins. Attachment of monomeric or polymeric ADP-ribosyl groups to a protein by transfer from NAD⁺:

Adenine Nicotinamide



Protein (ribose-P-P-ribose)_n + Nicotinamide + H⁺, where n can vary from 1 to 50. Poly ADP-ribosyl groups represent a novel homopolymer of repeating ADP-ribose units linked 1'-2' between respective ribose moieties:



Phosphoadenylylsulfate reductase from *Saccharomyces cerevisiae* requires NADPH and has been partly purified and fractionated.

The free energy of hydrolysis of the β-N-glycosidic linkage of NAD⁺ is -34.35 k Joules (-8.2 kcal)/mole at pH 7 and 25°C; it is therefore a so-called high energy bond, and NAD⁺ can act as an ADP-ribosyl transferring agent. The transfer of one ADP-ribosyl group (n=1 in above equation) is catalysed by ADP-ribosyl transferase. Formation and concomitant transfer of poly ADP-ribose to an acceptor gets catalysed by

poly (ADP-ribose) synthetase (n is greater than one in the above equation).

Adrenal Corticosteroids, Adrenocorticoids, Corticosteroids, Corticoids, Cortins. An important group of steroid hormones, formed in the adrenal cortex in response to adrenocorticotrophic hormone. These are structurally related to progesterone (see Steroids); they contain a carboxyl group with a neighboring α, β -unsaturated bond in ring A, a ketol side chain in position 17, and other oxygen functions, particularly in positions 11, 17, 21 and 11.

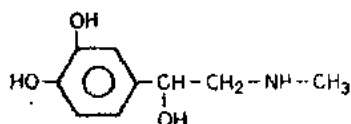
More than 30 steroids have been found in the adrenal cortex.

These are biosynthesized from cholesterol via progesterone; the latter is converted into A.C. by stepwise hydroxylation in positions 17, 21 and 11.

Adrenal Gland, Suprarenal Gland, Glandula Suprarenalis. A heavily vasculated, vertebrate endocrine gland, weighing about 15 g in the adult human. There are two adrenal glands one just above each kidney. The adrenal gland consists of two developmentally and functionally distinct parts: the mesodermal adrenal cortex (AC) and the ectodermal adrenal medulla (AM). The AC, which contains three histologically distinct zones, produces and exports glucocorticoids (see Cortisol) and mineralocorticoids (see Aldosterone) in response to the action of the pituitary hormones, corticotropin and renin/angiotensin II, respectively. The AC also produces sex steroids.

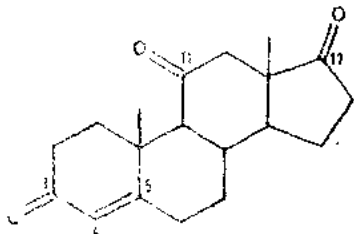
Adrenalin, Epinephrine: 4-[1-hydroxy-2-(methylamino) ethyl]-1, 2-benzenediol. It is a catecholamine hormone and drug. The L-form is physiologically active, affecting carbohydrate metabolism and the circulatory system.

It is synthesized in the adrenal cortex and sympathetic nervous system from tyrosine (via dopa, dopamine and noradrenalin), stored in the chromaffin granules and released into the blood stream upon nervous stimulation by the nervus splanchnicus. It is an adrenergic neurotransmitter.



Adrenalin.

Adrenosterone androst-4-ene-3, 11, 17-trione. It is a steroid derived from androstane. It is synthesized in the adrenal cortex and is considered one of the male gonadal hormones, due to its weak androgenic effect.



Adrenosterone

Aflatoxins Refer to microbial products belonging to the group of mycotoxins. They are natural carcinogens, causing liver cancers, and they are 100 times as active as previously known liver carcinogens. They are produced by *Aspergillus flavus*, *Aspergillus parasiticus* and *Aspergillus oryzae*, as well as some *Penicillium* strains.

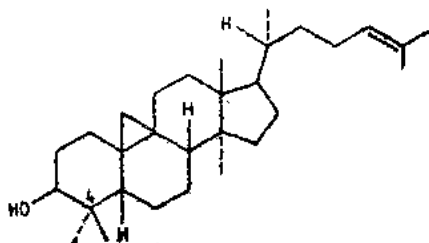
They are coumarin difuran derivatives.

AGA. Abb for N-Acetylglutamate.

Agar-agar. A polysaccharide plant slime from various red algae. It consists of about 70% polygalactan, which is about 70% agarose and 30% agarpectin.

Agglutination. Means the clumping of insoluble antigens bound to particles, such as bacteria, viruses, erythrocytes, by the appropriate antibodies.

Agnosterol: 5 α -lanosta-7, 9 (11), 24-trien-3 β -ol, a tetracyclic triterpene alcohol derived structurally from 5 α -lanostane (see Lanosterol. M, 424.7, m.p. 165°C, $[\alpha]_D^{25} + 66^\circ$. It is a zoosterol



Agnosterol

AICAR. Abb. for 5(4)-Aminoimidazole-4(5)-carboxamide ribotide.

AIR. Abb. for 5-Aminoimidazole ribotide.

Ajmaline. A Rauwolfia alkaloid, m.p. 205 to 207°C, $[\alpha]_D^{20} = +144^\circ$ ($c=0.8$ in chloroform). It is used medicinally to normalize heart rhythm. In high doses it has the tranquilizing effect of Rauwolfia alkaloids.

Alanine, Amino propionic Acid: M, 89.1; 1. L- α -alanine, abb. Ala, $\text{CH}_3\text{-CH}(\text{NH}_2)\text{-COOH}$, a proteogenic amino acid. m.p. 297°C (d.), $[\alpha]_D^{25} = +1.8$ ($c=2.0$, water). Ala is glucogenic and is closely involved in the metabolism of sugars and organic acids. It is one of the main components of silk fibroin.

2. β -Alanine, $\text{H}_2\text{N-CH}_2\text{-CH}_2\text{-COOH}$. A nonproteogenic amino acid, m.p. 196°C (d.). It occurs in free form, for example in the human brain, and is a component of the dipeptides carnosine and anserine, and of coenzyme A.

Alar 85. See N-Dimethylsuccinamide.

Albizzin, 2-amino-3-ureidopropionic Acid: $\text{H}_2\text{NCONHCH}_2\text{CH}(\text{NH}_2)\text{-COOH}$. A nonproteogenic amino acid which is occurring primarily in species of the genus Albizzia. It is presumably formed from carbamylphosphate and 2, 3-diaminopropionic acid by transcarbamylation. It is an antagonist of glutamine.

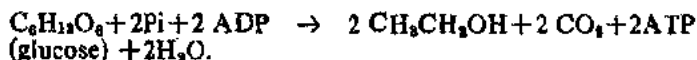
Albomycin. An antibiotic which is synthesized by Actinomyces subsp. It is a cyclic polypeptide with a pyrimidine base (cytosine) (Fig.). It is effective against both Gram-positive and Gram-negative bacteria, and inhibits the aerobic metabolism of Staphylococcus aureus and Escherichia coli.

Albumins. Refers to a group of simple proteins. They are found in body fluids and tissues and in some plant seeds. Serum albumin (plasma albumin) makes up 55 to 62% of the serum protein, and is one of the few carbohydrate-free proteins in blood plasma, or the serum obtained from it by clotting. Human serum albumin consists of a single polypeptide chain of 548 amino acids, which are stabilized by 17 disulfide bridges. In ovalbumin, one serine residue is esterified with phosphate.

Alcohol Dehydrogenase, abb. ADH (EC 1.1.1.1). A zinc-containing oxidoreductase which, in the presence of NAD^+ , reversibly oxidizes primary and secondary alcohols to the corresponding aldehydes and ketones. It occurs in bacteria, yeasts, plants and the liver and retina of animals.

Alcoholic Fermentation. The anaerobic (occurring in the absence of oxygen) formation of ethanol and carbon dioxide from glucose. The most important fermenting organism are yeasts and other microorganism. For lack of pyruvate decarboxylase, there is no alcoholic fermentation in animals. The process produces energy under anaerobic conditions: the fermentation of 1 mol glucose yields 1 mols ATP.

The starting point for A. f. has been glucose 6-phosphate, which is converted by the glycolysis reactions to pyruvate. Pyruvate is the branching point for the last step of carbohydrate degradation and gets decarboxylated by pyruvate decarboxylase (EC 4.1.1.1) to acetaldehyde, which is then reduced to ethanol by alcohol dehydrogenase (EC 1.1.1.1. Balance :

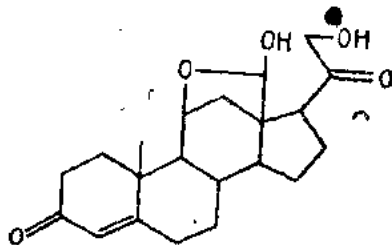


Alcohols. Hydrocarbon derivatives carrying one or more hydroxyl (-OH) group. In nature alcohols in the form of esters are important components of the essential oils, fats and waxes. A number of lower A., ethanol for example, are formed by fermentative processes from carbohydrates and proteins.

Aldonic Acids. The monocarboxylic acids which are (derived from aldoses by oxidation of the aldehyde group. Some important aldonic acids are L-arabonic acid, xylonic acid, D-gluconic acid D-mannonic acid and galactonic acid.

Aldoses. The polyhydroxyaldehydes, one of the two main subdivision of monosaccharides. These are characterized by their terminal aldehyde group -CHO, which is always given the number 1 in systematic nomenclature.

Aldosterone. 11 β ,21-dihydroxy-3, 20-dioxopregn-4-en-18-al-11 \rightarrow 11-hemiacetal, a highly active mineralocorticoid hormone from the



Aldosterone