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Co-Enzyme Chemistry or positionic

CO-FACTORS AS DERIVED FROM VITAMINS, CO-ENZYMES, PROSTHETIC GROUPS & APOENZYMES

intact molecule or conjugated protein as holoenzyme. co-enzyme, the protein part of conjugated protein is known as apoenzyme and the an enzyme & hence this dializable material (prosthetic group) is termed as clearly indicates that the dializable component is necessary for the protein to act as the activity can be regained by mixing the two separated components. This fact dialysis of such enzymes resulted in the loss of catalytic activity of that enzyme; but conjugated proteins (enzymes) can be separated by dialysis and it was seen that is known-as-prosthetic-group. The two fragments (protein + prosthetic group) of some proteins. The non-protein part (non-amino acid) of a conjugated protein or enzyme We know enzymes are protein molecules. Some enzymes are simple proteins, i.e., their molecules consist of only amino acids, whereas others are conjugated

Holoenzyme (enzyme) ==== Apoenzyme + Cgenzyme

Conjugated protein ----- Protein + Prosthetic group

Carboxylase Protein + Thiamine pyrophosphate or

Co-carboxylase.

co-factor but every co-factor is not co-enzyme. Most of the coenzymes are organic prosthetic group constitutes the co-enzyme. Thus every coenzyme is a nucleotides and are composed of vitamins. Co-enzymes may be classified according example, in metalloprotein enzyme, the metallic ion is not the co-enzyme but only co-factors which are organic molecules & participate in the catalytic process. For to their function into hydrogen-carrying & group-carrying co-enzymes & co-facto now-a-days term cofactor is used in general way & coenzyme specifies for those Thus Co-enzyme part is necessary for the activity of the enzyme, But

(I) Hydrogen Carrying Pyridine nucleotide Coenzyme . (2) Co-factor

Havin nucleotide Ascorbic acid Glutathione Choline Altamin B12 Inositol Vitamin K. Coenzyme A

(3) Group-Carrying Coenzymes Adenosine phosphate

Sugar phosphate Cytidine phosphate Guanosiné phosphate Uridine phosphate

filamine pyrophosphate

Pyridoxal phosphate

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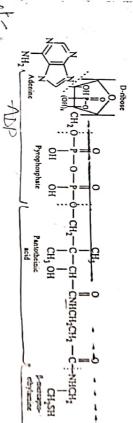
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STRUCTURE & BIOLOGICAL FUNCTIONS OF SOME COENZYMES

1. CO-ENZYME A (COA-SH)

established by a series of selective enzymatic degradations. in transferring the acetyl group from one compound to another its structure was It is a part of enzyme which catalyses biological acylation reactions, i.e., it helps



of fatty acids, terpenoids and steroids in plants and animals, units, thus coenzyme A is involved in carbohydrate metabolism, in the biosynthesis (It participates in all biosynthetic processes which proceed by way of two carbon

butyrylcoenzyme by various reactions. self-condensation to form acetoacetyl coenzyme .A which is converted into Biosynthesis of fatty acids: Acetyl coenzyme A, CoA-SCOCH3, undergoes

CoA-SCOCH2 H + CoA-S COCH3 COA SCOCH2COCH3 + CoA-SH

CoA-SCOCH=CH-CH3 (-H2O CoA-SCOCH2-CH-CH3

CoA—SCOCH2CH2CH3 Butyryl coenzyme A.

butyroacetyl-CoA; repetition of these sequences finally leads to the formation of a butyryl-CoA now again condenses with acetyl-CoA and in a similar manner forms long chain fatty acids. We see that two carbon atoms are added in acetyl-CoA to form butyryl-CoA;

 $\texttt{COA-SCO-CH}_2\text{-}\texttt{CH}_2-\texttt{CH}_2-\texttt{H}+\texttt{COA-SCOCH}_3\longrightarrow \texttt{COA-S-CO-CH}_2\texttt{CH}_2\texttt{CH}_2\texttt{COCH}_3$

HOOC(CH₂)₄CH₃ + COA—SH ← Hydrolysis COA—S | CO(CH₂)₄CH₃ (i) -H20 (iii) Reduction (i) Reduction

(α/νθυή) (Δ) /Biosynthesis of Terpenoids & Steroids: Isopentyl pyrophosphate and β: β-dimethylallylpyrophosphate which are the precursors of terpenoids & steroids biosynthesis are synthesised with the help of COA. An example is given below:

VOJCO COV (a) Hydrotysis

Glucose 6-pinospituse

B-hydroxyisovaleryl-COA IIIV-COV CO.CO.A

Further, it was observed that one molecule of adenosine & three molecules of pantothenic acid, adenosine phosphate & an unidentified sulphur-containing product. Structure of Co-enzyme A: On enzymatic hydrolysis coenzyme A gives

Isovaletyt-COA

β-methylcrotonyl-COA

enzymatic studies the monophosphate ester was found to be present at the phosphate were produced for each mole of pantothenic acid. and 4'-position of pantothenic acid. me pyrophosphate group is present as a bridge between the 5'-position of adenosine nydrolysis of coenzyme A yielded pantothenic acid-4'-phosphate which indicates that 3-position of ribose portions of adenosine moiety of he coenzyme. Alkaline monophosphate and the other two as pyrophosphate ester grouping. By the Out of the three moles of phosphates one was found to be present as

compound obtained from coenzyme A). 2-aminoethanethiol since it was found to be degraded product of pantetheine (a The structure of the sulphur-containing compound was established as

pantothenic acid) in the coenzyme A. Ribose sugar was also one of the degradation products of COA. Hence the structure of coenzyme A may be written as: (formed by the amino group of the aminoethanethiol and carboxyl group of the The characterization and synthesis of pantetheine pointed out an armide finkage

(II) Thiamine Pyrophosphate [Co-carboxylase]

co-carboxylase for the action, breaks down pyruvic acid into acetaldehyde in fermentation and carbohydrate metabolism. CH3 COCOOH Co-carboxylase) moiety. The enzyme carboxylase, which requires the co-enzyme The biological activity of thiamine is mainly due to its pyrophosphate ester CM3 COH

OLMALULOU GCH3.CO.COOH Enzyme CH3CHO + CO2 Pyruvic acid

& a-ketoglutaric acid into citric & succinic acids respectively in respiration (Kreb's The enzyme is also responsible for the oxidative decarboxylation of pyruvic acid

The structure of co-carboxylase is:

(III) Pyridoxal Phosphate [Codecarboxylase or Co-transaminase]

transamination, racemization, decarboxylation and elimination reactions. a number of important metabolic reactions of the α-amino acids, e.g., In transamination the amino acid is converted into keto acid and vice-versa phosphale is obtained by phosphorylation of pyridoxal. It is involved

e.g., the interconversion of glutamic acid into its keto acid & of a keto acid to amino

its structure, e.g., conversion of serine into pyruvic acid with the elimination of one molecule of ammonia Elimination reactions are also catalysed by an enzyme having pyridoxal unit in

phosphate as a overzyme, e.g. formation of histamine from histidine. The general reaction is: The enzymes which decarboxylate amino acids also require pyridoxal

CO-ENZYME CHEMISTRY

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The structure of pyridoxal phosphate is:

hydrogen to oxygen, forming water. The overall result is oxidation of substrate cytochrome c, cytochrome n and cytochrome oxidase. The last compound gives its dinucleotide. This is hydrogen transfer co-enzyme & its activity is due to transfers step by step to other compounds such as flavoprotein, cytochrome by nicotinamide. It accepts hydrogen from substrate (which is oxidised) and then Transference of hydrogen is reversible and stereospecific. I or Coenzyme I or Cozymase. NAD[©] stands for nicotinamide adenine It is also known as DPN (diphosphopyridine nucleotide) or Codehydrogenase

CH3CHO is reduced to CH3CH2OH by means of NADH. One important use of NAD^e is its use during the alcoholic fermentation where

(V) NADP^{\oplus} [Nicotinamide Adenine Dinucleotide Phosphate]

adenosine. It also helps in dehydrogenation. phosphate group apart from DPN molecule in position 2' of ribose molecule of (Triphosphopyridine nucleotide) or codehydrogenase—it. It has one additional It is also known as Coenzyme II or phosphocoenzyme or TPN

Structure: NADP[®] on hydrolysis by a nucleotide phosphatase gives

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