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Nomenclature and Classification of Enzyme part-A

Introduction

Enzymes are biological catalysts that increase the rate of chemical reactions by lowering the activation energy. The molecules involved in the enzyme mediated reactions are known as substrates and the outcome of the reaction or yield is termed product. Generally, the chemical nature of most of the enzymes are proteins and rarely of other types (e.g., RNA). Sometimes the enzyme needs the presence of a non-protein component (co-enzyme, if it is a vitamin derived organic compound or co-factor, if it is a metal ion) for accomplishing the reaction. In this case, the whole enzyme may be called a holoenzyme, the protein part as apoenzyme and the non-protein constituent a prosthetic group.

Perhaps the most distinctive feature of enzyme-based catalysis is its specificity. Chemical catalysts display only limited selectivity and specificity, whereas enzymes shows several levels of specificity like, for the reactants, susceptible bond involved in the reaction, substrate groups and the type of spatial orientation.

Enzyme Nomenclature

Enzymes are classified into six different groups according to the reaction being catalyzed. The nomenclature was determined by the Enzyme Commission in 1961 (with the latest update having occurred in 1992), hence all enzymes are assigned an “EC” number. The classification does not take into account amino acid sequence (ie, homology), protein structure, or chemical mechanism. EC numbers are four digits, for example a.b.c.d, where “a” is the class, “b” is the subclass, “c” is the sub-subclass, and “d” is the sub-sub-subclass. The “b” and “c” digits describe the reaction, while the “d” digit is used to distinguish between different enzymes of the same function based on the actual substrate in the reaction.

Enzyme Nomenclature Principles

The sixth complete edition of Enzyme nomenclature was published under the patronage of the International Union of Biochemistry and Molecular Biology (formerly the International Union of Biochemistry). By the late 1950's it had become evident that the nomenclature of enzymology was not following the guidelines formulated owing to an increase in the number of enzymes.

The naming of enzymes by individual workers had proved far from satisfactory in practice. In many cases the same enzymes were known by several different names, while conversely the same name was sometimes coined to different enzymes. Many of the names conveyed little or no idea about the nature of the reactions catalyzed.

To solve this problem, various attempts have been made to bring an order into the general nomenclature of enzymes. Because of their close interdependence, it is convenient to deal with the classification and nomenclature together.

A consequence of the adoption of the chemical reaction as the basis for naming enzymes is that a systematic name cannot be given to an enzyme until it is known what chemical reaction it catalyzes. This applies, for example, to a few enzymes that have so far not been shown to catalyze any chemical reaction, but only isotopic exchanges; the isotopic exchange gives some idea of one step in the overall chemical reaction, but the reaction as a whole remains unknown.

A second consequence of this concept is that a certain name assigned to enzymes is not applicable to single enzyme protein but a group of proteins with the same catalytic property.

Enzymes from different sources (various bacterial, plant or animal species) are also classified as one entry. The same even applies to isoenzymes. However, there are exceptions to this general rule. Some are justified because the mechanism of the reaction or the substrate specificity is so different as it ought to have different entries in the enzyme list. This applies, for example, to the two cholinesterases, EC 3.1.1.7 and 3.1.1.8, the two citrate hydrolyases, EC 4.2.1.3 and 4.2.1.4, and the two amine oxidases, EC 1.4.3.4 and 1.4.3.6).

A third general principle approved is that the enzymes are divided into groups on the basis of the type of reaction catalyzed, and this, together with the name(s) of the substrate(s) provides a basis for naming individual enzymes. It is also the basis for classification and code numbers.

Common and Systematic Names

The first enzyme commission gave much thought to the question of a systematic and logical nomenclature for enzymes and finally recommended that there should be two nomenclatures for enzymes, one systematic and the other trivial. The systematic name of an enzyme, formed in agreement with definite set of rules, exposing its action exactly, thus identifying the enzyme precisely. The trivial name was amply short enough for general use.

The commission for revision of enzyme nomenclature discussed this problem at length and breadth and a change in emphasis was made. It was decided to give the trivial names more prominence in the enzyme list; they now follow immediately after the code number and are described as common name. However, it was decided to retain the systematic names as the basis for classification for the following reasons:

(i) The code number alone is only useful for identification of an enzyme, whereas the systematic

name is self-explanatory.

- (ii) The systematic name reveals the type of reaction catalyzed by the enzyme.
- (iii) Systematic names can be formed for new enzymes by the discoverer, by application of the rules, but individuals should not allot the code numbers. Only the nomenclature committee of IUBMB should assign a number.
- (iv) Common names for new enzymes are frequently formed as a condensed version of the systematic name; therefore, the systematic names are helpful in finding common names that are in accordance with the general pattern.

Scheme for the Classification of Enzymes and the Generation of EC Numbers

The first Enzyme Commission, in its report in 1961, devised a system for classification of enzymes that also serves as a basis for assigning code numbers to them, which was approved by the last commission in 1992. These code numbers are prefixed by EC, which are now widely in use, contain four elements separated by points, with the following meaning:

- (I) The first number shows to the main class that an enzyme belongs.
- (II) The second figure indicates the subclass.
- (III) The third figure gives the sub-subclass.
- (IV) The fourth figure is the serial number of the enzyme in its sub-subclass.