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CATALASE ENZYME IN PLANT / A REVIEW ARTICLE

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Abstract
Enzymes work as a catalyst to speed up chemical reactions in plants and to ensure that the chemicals that are manufactured in the plant are the appropriate form, as molecules that have the same chemical formula can take two different forms that represent identical images of each other called isomers, as the catalase enzyme catalyzes the reaction that breaks hydrogen peroxide into water and oxygen. The level of constructive metabolism shows how much oxygen is produced over the time during which this reaction occurs with or without catalase. The reaction produces more oxygen in the presence of catalase use of enzymes an important role in stimulating chemical reactions, as they directly form gas bubbles, which is evidence that the test is positive (Catalase +ve), and if bubbles of oxygen gas do not rise, the result will be negative for this test (Catalase negative).

Keywords: Catalase, Plant, Antioxidant, Peroxidative.

Introduction

The primary function of catalase in plants is to protect tissues from toxic effects. Hydrogen peroxide (H2O2) also removes electrons which lead to the production of (O2) catalase is found in all aerobically breathing organisms and in cells that contain cytochrome c. The first enzymes to be studied and purified were bacteria, birds, and animal livers. Human liver has also been purified in large quantities due to its vital importance. The factory was also part of Enzyme study and purification [1]. The plants in which the effectiveness of catalase has been studied are spinach and apple fruit, yellow in color, enzymes are sensitive to temperature, as the change in temperature is associated with a maximum by changing the structure of the primary and secondary protein and the active form, which leads to protein mutation. Angiosperm species studied to date all contain three catalase genes, this includes monocots and dicots such as tobacco, Arabidopsis, maize, pumpkin, and rice[2]

1-1 Denaturation pH also affects the nature of the enzyme and the pH values:

The maximum action of the enzyme leads to a decrease in its effectiveness and stability. In general,

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whether the optimum pH for enzyme action depends on the enzyme source[3]. Plant cells contain an antioxidant system consisting of small molecules whose nature varies according to the types of oxidation and are found in most types of plants [4]. The antioxidant system has an important role in controlling active free oxygen species, which play an important role in increasing exposure to oxidation and its damage in plant cells antioxidant systems are also divided into two parts: the first part is the enzymatic antioxidant system and the second part is the non-enzymatic antioxidant system. Each component of these two parts has an important and effective role in removing free radical damage and the catalase enzyme is considered one of the components for this system[5]:

It was mentioned [6] that the enzyme catalase is one of the important enzymes in the decomposition of H2O2 generated during stresses, and it represents the second stage of the defense system in plant cells and tissues after the enzyme (Super oxide dismutase) SOD, as it receives H2O2 and turns it into a water molecule. And oxygen, and the Cat enzyme is found in certain organs such as peroxisomes and glyoxysomes, as well as in mitochondria, cytoplasm, and plasmids [7]. The enzyme is composed of proteins containing an iron group and has three enzyme similarities, including the researcher and also the , which are Cat1, Cat3, and Cat2[8].

It has become clear through studies on the effects of various types of stresses in reducing damage to antioxidant systems, specifically the Cat enzyme, as it is clearly affected by various stresses such as water stress, as well as salt stress and aging conditions. The increase in free radicals has the effect of reducing the effectiveness of Cat and other antioxidant enzymes and thus causes an increase in dissolution and toxic cellular effects by oxidizing membrane lipids and cellular proteinsp[9]. Also, aging and the effect of the aging phenomenon are clear in reducing the effectiveness of the oxidation system, such as the Cat enzyme. It has been shown in the tobacco plant Nicotiana tabacum that the effectiveness of the system decreases with the advancing age of the leaf also noted that the effectiveness of the Cat enzyme decreases as a result of the effect of the aging phenomenon in the cuttings of the Mung plant, Phuseolus aureus Roxb, and the effectiveness decreases in both the leaves and the supracotyledonous and subcotyledonous stems compared to the effectiveness of the enzyme in fresh cuttings[10]. This has a close relationship with the decrease in the appearance and formation of adventitious roots in the mind. Other types of stress also have a clear effect on the activity of the enzyme. It has also been observed that water deficit stress in the pea plant (Pisum sativum) affects the reduction of the activity of the Cat enzyme .It was also noted that the activity of the enzyme and the rest of the types of antioxidant system is directly affected by salt stress, as the activity of the enzyme SOD and Peroxdose decreases, as does the activity of Cat [11].. They also noted that the callus of the sunflower plant, Helelianthus annuns L., decreases the effectiveness of the system. Antioxidants, especially the Cat enzyme, when treated with KCl salt for three weeks, compared to the activity of the enzyme in the cup not exposed to salt stress[12].

1-2 Chemical Nature:

Catalase is a ferroporphyrin enzyme. Catalase consists of two groups; The protein unit and active group, a roe-like prosthetic group called hematin, the protein is attached to the active group via its carboxyl groups, when the source of catalase differs, its properties will also differ, such as molecular weight, activity, etc. The differences between one type of catalase and others are mainly in the protein structure and in the number of compensatory groups (hematin). By estimating the spectral intensity of protohematin and the iron content of the enzyme, it was found that animal

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catalase contains 4 active compensatory groups, while plant catalase contains only one group catalase is a tetramer and consists of four polypeptide chains, each chain containing more than 500 amino acids[13].

1-3 Mechanism of action:

The reason catalase is included in the category of catalytic substances is its ability to decompose hydrogen peroxide into water and molecular oxygen. In order for this reaction to take place, it requires two molecules of hydrogen peroxide, the first acting as an electron acceptor and the second as an electron donor [14].

$$2\ H2O2 \rightarrow 2\ H2O + O2$$

1-4 Catalase inhibition:

Hematin iron-blocking compounds, such as cyanide, azide, sulfide, and hydroxylamine, work to inhibit all hydroprotein enzymes (containing iron), including catalase. Catalase is characterized by the fact that it is inhibited by other, non-specialized substances such as nitrite, chlorine ions, acetate, phosphate, and sulfate. The reason for this is the participation of these ions compete for places in the enzyme's iron. Acids also affect the activity of catalase and stop it completely, even at low concentrations. The reason is that the acid blocks the hydroxyl (which is related to hydrogen peroxide) from the active center of the enzyme. An example of this is formic acid in low concentration (0.02 molar) [15].

1-5 Peroxidative function of catalase enzyme:

Under very low concentrations of hydrogen peroxide (hydroxide) (no more than 10−9 M), catalase oxidizes ethanol, methanol, formaldehyde, and nitrates. Thus, it is similar to the action of other enzymes such as alcohol dehydrogenase, xanthine oxidase, and amino acid oxidases, but the speed of oxidation in this case is slow compared to specialized enzymes, and if the percentage of hydrogen hydroxide increases, it will oxidize it and stop oxidizing alcohol. Can prepare catalase enzyme by dissolve the 111 mg of catalase in 500 mL of distilled or deionized water. The result is a 400 units/mL catalase solution. Proper storage of powdered catalase requires refrigeration or freezing and the shelf life of many enzymes is poor. All enzymes should be used within one year of purchase[16].

1-6 Effect of catalase on plant leaves:

There is a direct relationship between the production of chloropigment pigments and the activity of catalase. This means that when the enzyme is activated, the rates of chloropigment production increase, when enzyme activity decreases, chloroplast production rates decrease. It was found that pale green leaves have high catalase activity. Cells make the enzyme catalase to remove hydrogen peroxide. Different plant materials show very different amounts of catalase activity – and the most metabolically active tissues show the greatest activity[17].

1-7 Biological role and status of catalase enzyme:

Hydrogen hydroxide has a toxic effect when its concentration in the cell increases, so catalase is very important as it breaks down excess hydrogen hydroxide in the cell. In addition, it supplies tissues with molecular oxygen, as it is difficult for this oxygen to reach these tissues, the enzyme is widely present in some terrestrial plants, such as potatoes. This enzyme is extracted by soaking mashed potatoes in pure distilled water and keeping the solution or enzyme at a cold temperature [15]. In plants, there may be up to 5 isotopes in some tissues, and three isotopes in the endosperm. In humans, there are only two forms, which are bound to peroxysomes and the other is dissolved.

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The ratio between these two is used to identify some diseases in humans[18].

2- Conclusions

Catalase is located in all major sites of H2O2 production in the cellular environment (such as peroxisomes, mitochondria, cytosol and chloroplast) of higher plants. Multiple molecular forms of catalase isozymes indicate its versatile role within the plant system. Production of catalase of the invention may be produced by aerobic cultivation of the above microbial strain on a nutrient medium containing suitable carbon and nitrogen sources, such media being known in the art. A temperature in the range 40-60°C is suitable for growth and catalase production

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