AN OVERVIEW OF ENZYMES AND THEIR USE IN THE DETERGENT INDUSTRY

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ABSTRACT

Chemical usage has grown quickly in many industries across the globe, posing a threat to human health. In terms of sustainability and process efficiency, enzymes as industrial biocatalysts provide benefits over out-of-date chemical processes. This item covers the enzyme, including its many forms, as well as its uses in the detergent industry. Enzymes may assist decrease the amount of chemicals needed in conventional detergents, reducing their environmental effect since they're recyclable, non-toxic, and leave no hazardous residues behind. Additional enzymes, in addition to lipases, are widely utilized in household cleaning goods, laundry, agriculture, medicine, and other fields. The use of enzymes as detergents, particularly lipases, is discussed in this article. Lipases are a fat-based enzyme used in detergents to remove stains such as salad oils, fried fat, butter, fat-based items, lipstick soup, biological sebum, and soup. Lipases have a wide range of specificity. The primary benefit of using enzymatic detergent is that it is both cost efficient and environmentally friendly. Although biological implementations for industrial purposes, as well as certain advancements for increasing the stability and performance of detergent lipases enzyme, have previously been completed, there are still important opportunities for future study.

KEYWORDS: *Catalysts, Detergent, Enzyme, Lipases, Protein.*

1. INTRODUCTION

Enzymes are biotransformation agents (also known as biocatalysts) that aid living organisms in increasing the rate of biological processes. This substance can be extracted from live cells and used to catalyze a wide range of important economic activities. E.g Enzymes are utilized as washing powder and other cleaning products, as well as analytical instruments and tests that have forensic, therapeutic, and environmental uses. The word "enzymes" was first used in 1878 by German scientist Wilhelm Kühne, who was discussing yeast's ability to produce alcohol from carbohydrates[1].

In the late nineteenth and early twentieth centuries, many advances were made in enzyme extraction, characterization, and commercialization, yet enzymes did not stay crystallized until the 1920s, suggesting that catalytic efficiency is linked to protein molecules. For the next 60 years or more, enzymes were thought to be nothing more than proteins. However, it was discovered in the 1980s that biological molecules such as ribonucleic acid (RNA) may catalyze processes. Despite these notable exceptions, conventional enzymology, as well as the remainder of this article, is focused on proteins having catalytic properties.

Enzymes are biocatalysts that help living organisms speed up their processes. Enzymes are essential for converting substrate to product; without enzymes, substrate would not be converted into product. The enzyme substrates will not convert into products if it is not present. Enzymes are catalysts that need just a little amount of energy to speed up processes without destroying them [3]. Enzymes are often characterized as having the ability to stimulate the production of substrate biomolecules in product molecules, demonstrating how a substrate molecule may be converted into a product with the aid of an enzyme[2].

1.1.Enzyme Types Include:

All enzymes that produce oxido-reductions are classified as oxidoreductases. A hydrogen and electron donor is a term used to describe an oxidized substrate. To categorize the enzymes, the oxidoreductase 'donor: acceptor oxidoreductase' is employed. Wherever possible, the term 'dehydrogenase' is used; alternatively, the term 'acceptor reductase' may be used[3].

1.1.1. Transferases:

Transferases are enzymes that transfer a molecule through one chemical (commonly referred to as the donor) to another (usually referred to as the receiver) (generally regarded as acceptor). The 'donor: acceptor cell transferase' method is used to classify the cells. Glycosyltransferase, acyl transferase, nitrogen transferases, and other enzymes.

1.1.2. Hydrolases:

These enzymes catalyze the hydrolysis of various bonds. Because some of these enzymes have such wide specificities, it may be difficult to determine if two formulations reported by different authors are the same or should be classified as distinct. The common term is typically made up of the substrate's name simply by suffix–ase, e.g. Protease, Lipase, Glycosidase, etc., since the scientific name always includes the word 'hydrolase.'

1.1.3. Lyases.

Lyases are non-hydrolytic or oxidative enzymes that cleave C-C, C-N, C-O, or other distinct bonds. They differ from conventional enzymes in that one reaction route requires two or more substrates, whereas the other reaction pathway requires one molecule less. When acting on a single substrate molecule, the molecule is eliminated, and a new double bond or ring is form.

1.1.4. Ligases:

Ligases are enzymes that catalyze the binding of two compounds while hydrolyzing the diphosphate link in Adenosine Triphosphate (ATP) and another triphosphate at the same time. 'Ligase' is the most frequent common name, but'synthase' or 'carboxylase' are also used sometimes. Enzymes of every main kind. Enzymes that are often used in detergents fall into four categories:

1.1.5. Proteases:

The most commonly employed enzyme in the cleaning business cleans protein stains that have a high propensity to bind to textile fibres, such as blood, egg, grass, as well as human sweat. Amylases are enzymes that break down starch in foods like spaghetti, potatoes, custards, gravies, and chocolate.

1.1.6. Lipases:

Fatty ingredients should be broken down using lipases. Butter, fats, salad oil, sauces, and even tough stains from collars and cuffs may all be removed with Lipase. Cotton and cotton blends have their cellulose fibre structure changed by cellulases. It softens the cloth, enhances the color, and eliminates filth when combined to an enzyme-based detergent.

Lipase has its origins in organic chemistry and biotechnology, and it is the most frequently used enzyme category. Lipase enzymes are present in both prokaryotes and eukaryotes (plant, animal and fungi). Lipase derived from microbial and animal sources is often used. Trypsin, an amino acid with a bitter taste, is present in pig pancreatic lipase[4].

The lipase enzyme is utilized in the manufacture of detergent in this study. Lipases, particularly microbial lipases, are important commercial biocatalysts, and novel techniques for screening, generating, and purifying lipase enzyme from bacterial communities are continuously being developed to satisfy the demands of the pharmaceutical and food industries. Several cost-effective and efficient methods for boosting lipase production in microbial strains have recently been tested. Lipases are hydrolytic enzymes that hydrolyze and catalyze the hydrolysis and catalysis of insoluble triacylglycerol into glycerol, free fatty acids, and acylglycerols. Lipases are a kind of esterase that catalyze reactions at the lipid-water barrier using long chain triacylglycerols that are poorly soluble in water. Organic solvents and pH are very stable at extremely high temperatures. Lipases are very good at catalysing reactions in both non-aqueous and aqueous environments. Lipases have a hydrophobic lid, which is necessary for their interface activity[5].

Because of their high hydrophobicity, oils and fats are difficult to remove during low-temperature washing. Triglycerides are broken down by lipases into more water-soluble mono- or diglycerides, as well as free fatty acids and glycerol. All of these hydrolysis products are soluble under alkaline conditions. The effects of lipases on clothes are only noticeable after many wash cycles.

1.2. Lipases Have The Following Properties:

Since the 1980s, the number of accessible lipases has grown and been used as biocatalysts in businesses due to their numerous characteristics such as pH dependence, high catalytic state, temperature, bio-degradability, and high capacity. Amyl, isoamyl, isobutyl, as well as ethyl are examples of flavors esters. The action of lipase was investigated in two ways: hydrolytic and synthetic. One of the most desired properties of lipase is its capacity to digest mono, di, or free fatty acids. Lipases, on the other hand, carry out their reactions at low pH and temperatures, while direct reactions at high temperatures and pressures need more energy. Lipases also have the ability to activate without the need of a cofactor, as well as its organic stability[6], [7].

1.3. Reaction Catalyzed by Lipases:

Lipases are the most adaptable biocatalysts, capable of carrying out a wide variety of biotransformation processes such as hydrolysis, esterification, interesterification, amino lysis, alcoholysis, and acidolysis. In addition to their well-known capacity to cause lipid breakdown, lipases may also drive synthetic processes such as transesterification. Advantages of Enzyme-Based Detergents include:

Enzymes help break down stains that are tough to remove. The primary advantage of using a biological detergent is that it works at lower temperatures and requires fewer washes, saving time, energy, water, and money. At lower temperatures, it's more effective, and it's better at stain removal, but it's harder on oily skin. Lipases are used in a variety of ways[8].

Lipases are biocatalysts that are helpful in a variety of situations. Aside from triglyceride hydrolysis, they may catalyze other processes such as interesterification, esterification acidolysis, alcoholysis, or amino lysis. Because lipases are hydrolases, they do not need cofactors. Only a few regioselective lipases work on the ester bond at the sn-1 or sn-3 sites of triglyceride assembly, whereas the bulk of lipases work in the sn-2 site. Lipase with optimum activity may be obtained across a wide temperature range. The three-dimensional structures of many of these enzymes have been established, allowing for the creation of rational engineering strategies.

Lipases may be utilized in a variety of industries, including detergents, leather, food, textiles, fat and oil cosmetics, paper, and pharmaceuticals, to name a few. Despite the relatively large number of commercially available lipases, industrial applications are restricted due to the high cost of certain lipases, the small number of lipases available in industrial quantities, and the poor performance of some lipase-mediated techniques. Lipases are mostly used in the pharmaceutical, detergent, and food industries. Figure 1 depicts some of the most common uses for lipase enzyme[9].

1.4. Lipase in the Detergent Business: Ground porcine and cow pancreases, which are rich in lipases:

Were formerly used in the fine chemical industry as detergent additives. Lipase enzymes are used extensively in the detergent business, making it the most significant application for lipase enzymes. Cleaner enzyme accounted for 30% of the total enzymes market in 1995, with a market value of $30 million. In the year 2000, this market was valued $1.5 billion.

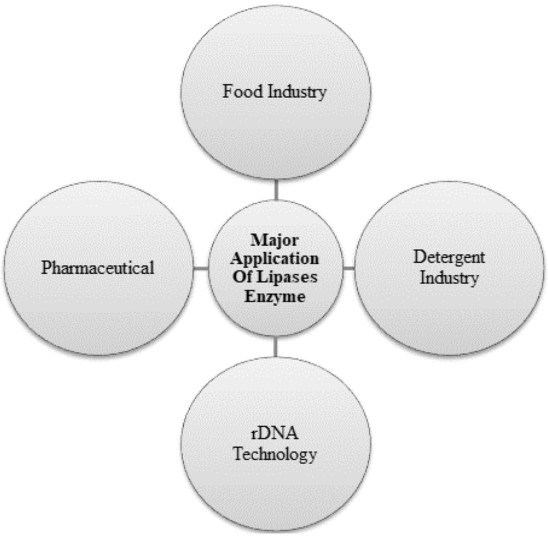

Figure 3: Illustrates some of the major applications of lipase enzyme.

Novozymes, formerly Novo Nordisk, developed Lipolase, the first industrial lipase designed for the detergent industry, in 1988. Lipolase requires a pH of 10.5–11.0 to function properly; it is very active at the optimum temperature of 40 °C and over a wide temperature range; it is constant in hydrolytic enzymes washing solutions; and it is oxidation stable, or even very stable toward a diverse array of detergent components, such as surfactants. This enzyme is frequently used to remove fat-consuming stains such as salad oils, fat-based sauce, fried fat, butter, human sebum, soups, and lipstick. Lipase has a broad range of substrate molecule specificity. These lipases are currently found in a broad range of high-end detergents all over the globe. Lipolase was modified in three ways by Novozymes: Lipex, LipoPrim, and Ultra.

Lipases enzymes are employed as functional components in detergents, helping in the development of effective, ecologically friendly, or energy-saving dish or laundry detergents. The three major kinds of cleaning enzymes are proteases, amylases, as well as lipases, each having its own set of benefits for usage in laundry or automated dishwashing. Protease enzymes were the first enzymes to be widely employed in laundry cleansers. Not only does this improve cleaning quality, but it also helps the environment. Lipases and amylases work along with proteases in industrial cleaning processes to improve detergent effectiveness, particularly at lower temperatures and pH levels. Cellulases assist with fabric care and keep washed clothes looking fresh.

Lipases and other hydrolases are extensively employed in the detergent business to improve product quality. Lipases degrade lipids, thus their lipolytic activity may remove some fatty acyl soils. Fatty acyl soils include sweat, lipstick, fried fats, butter, and sauces. Lipases in detergents may reduce the amount of time spent washing, agitation, and temperature, prolonging the life of textiles and providing a healthy environment for living creatures. The lipases enzyme has been utilized in the production of dishwashing cleansers, which has resulted in a reduction in the quantity of surfactant required in the process[10].

2. DISCUSSION

This review article is mostly on enzymes, their kinds, and their use in the cleanser industry. Enzymes are biocatalysts that aid in the speeding up of metabolic processes in living organisms. The usage of chemicals is constantly increasing, which is extremely damaging to us and our environment. Using enzyme-based products instead of chemical-based products is not only safer for us, but also more cost-effective. The primary benefit of enzyme-based products is that they are both environmentally benign and economically efficient. The drawback of enzyme-based products is that they require a long time to produce. Enzyme is a really useful and efficient chemical. Other significant and beneficial applications of lipase include the food and pharmaceutical sectors, as well as rDNA technology. In this paper, we look at how Lipases enzymes are used in the detergent industry.

Lipase is a fat-based enzyme that is frequently used in cleaners to remove stains such as fried fat, soups, butter, salad oils, lipstick, and human sebum. Lipase also has a broad range of substrate specificity. Lipases are also employed to kill bacteria that contain protein. Because it includes amylase and bio surfactant, lipase may be used as a detergent addition and is ecologically friendly. Enzymes are now extensively utilized in laundry detergents throughout the industrialized world, with enzymes accounting for more than half of all surfactants available. Despite the fact that the laundry business is the world's largest individual market for enzymes, little is known about the enzymatic utilized in the detergent industry?

Catalyst-based surfactants outperform synthetic detergents in terms of enhancing properties. These are not only efficient at low washing temperatures, but they are also environmentally friendly. When the discolouration is gone, enzymes in the surfactants keep the activity going. Enzyme-based surfactants also aid in the preservation of fabric condition and color vibrancy. Surfactants that are catalyst-oriented are utilized in a limited percentage as compared to synthetic compounds. These can withstand severe temperatures, are ecologically friendly, and are 100% biodegradable. Heat sensitivity, specificity, reversibility, including pH sensitivity, and catalytic activity are all important characteristics of enzymes.

3. CONCLUSION

Chemical usage is on the rise, which is very damaging to both living things and the environment. As a result of this research, we now know that using enzyme-based detergents is highly effective and has no negative influence on the environment. Enzyme is a really useful and efficient chemical. Other significant and beneficial applications of lipase include the food and pharmaceutical sectors, as well as rDNA technology. Lipase enzymes are often used in detergent formulations to remove fat-based stains such as fried fat, soups, butter, salad oils, lipstick, and human sebum. The lipase enzyme has a broad range of substrate molecule selectivity. Lipase is also used to kill bacteria that contain proteins. Because it includes amylase and bio surfactant, lipase may be used as a detergent addition and is ecologically friendly. Lipase is completely effective against all fat, oil, including butter-containing bacteria. The primary advantage of enzymatic dishwashing is that it is both economical and environmentally beneficial.In terms of boosting characteristics, catalyst-based surfactants beat synthetic detergents. These are not only effective at low wash temperatures, but they are also eco-friendly. Surfactant enzymes keep the action continuing after the discoloration is gone. Surfactants based on enzymes also help to maintain fabric condition or colors brightness. In comparison to synthesized chemicals, catalyst-oriented surfactants are used in a small proportion. These are resistant to extreme temperatures, environmentally friendly, and 100 percent biodegradable. Enzymes have essential properties such as heat sensitivity, specificity, reversibility, including pH sensitivity, as well as catalytic activity.

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