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PHARMACEUTICAL APPLICATIONS OF MARINE-DERIVED ENZYMES

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Abstract
Marine fungi can thrive at some seawater concentrations. Marine fungi have been proven to be undefinable on a physiological basis whereas a general ecological definition to name that the marine fungi of obligate types are the ones that develop and sporulate only in a marine and estuarine environment. Facultative forms are those from fresh water or terrestrial environments capable of growing in marine habitats. The initial research on marine fungi on mangroves has included taxonomy of marine fungi such as new species descriptions, fungi lists and surveys. This covers the marine fungi found in mangrove habitats. The extensive unexplored microbial diversity of soils holds promise for commercial exploration in biotechnology, in the fields of medicine, industrial processes, agriculture and bioremediation of contaminated wastes, water and land. The capacity of fungi to synthesize extracellular enzymes for decomposition of polymeric substrates like leaf litters is particularly crucial in the ecology of woodlands. Thanks to the action of a set of extracellular enzymes, fungi can break down most polymeric compounds of leaves (hemicelluloses, cellulose, starch, pectin and to some extent lignin). On the basis of leaf litter composition and water chemistry, fungal breakdown of leaf litter can last 1 to 6 months. It is somewhat otherwise with fungal breakdown of emergent macrophytes since it begins as standing shoots.
Keywords: Pharmaceutical, Marine, Enzymes, application.

1. INTRODUCTION

In nature, most of the environmental niches like oceans, rivers, soil, caves etc., containing millions of microorganisms are typically not rich in high nutrient content. The microorganisms that can thrive at very low nutrient conditions are referred to as oligotrophic compared to the copiotrophic/eutrophic microorganisms that need high levels of nutrients for continuous growth and metabolic activity. The word oligotroph is derived from two Greek terms "oligos" and "trophic" referring to low/little and nutrition respectively [1]. There are a number of criteria for the identification of oligotrophs as described in different research articles. It should be noted that there is confusion regarding the definition of oligotrophs based on the quantity of carbon source needed for growth. Some authors present maximum values of 1mg Carbon (C)/L for the concentration of the nutrient, and others indicate 5mg-15mg C /L as the concentration required for growth. Oligotrophs are most usually categorized based upon whether they are capable of growth in diluted nutrient broth or in Luria Bertani broth. Authors have referred to both the organisms, the one which would grow in 100 times diluted nutrient broth as well as the one capable of growing in 10,000 times diluted nutrient broth as oligotrophs. These organisms are also categorized as obligate or facultative oligotrophs. Obligate oligotrophs are characterized by their capability of growth at low nutrient only and which are inhibited at high inorganic or organic concentrations [2]. However, facultative oligotrophs can grow in low nutrient levels like the case of obligate oligotrophs but also in greater nutrient concentration such as copiotrophs. Facultative oligotrophs are not limited to low nutrient levels and are more capable in fluctuating nutritional levels [9]. Oligotrophic microbes are capable of thriving in environments with poor nutrition, in which they must contend with stiff competition for scarce organic and inorganic substances [17]. Their capacity to endure and thrive in such habitats is based on their extraordinary metabolic flexibility and efficiency in resource utilization [18]. The microorganisms have developed myriad mechanisms to salvage and reuse nutrients effectively in order to survive and propagate in environments where other organisms failb[10]. Unlike copiotrophs, which are high consumers of nutrients but poor absorbers of substrates when nutrients are present in low concentration, oligotrophs are superior in maximizing the uptake of inorganic and organic nutrients by the cell when nutrients are present in low concentration and can make use of such resources judiciously due to their slow growth rate [11]. Such features favor them to be predominant in ecosystems with hardly accessible or usable carbon [3]. Oligotrophic organisms are therefore defined by sluggish metabolic and growth rates, higher substrate affinity, and generally low population levels. These oligotroph growth capabilities under low nutrient conditions may also be searched for industrially relevant biomolecule production [13].

2. REVIEW OF LITERATURE

Enzymes are currently produced using microorganisms in large scale for various industrial applications. As per the international market study conducted by Grand View Research, world-wide the market for enzymes is increasing beyond anticipated levels from USD 4.2 billion in 2014 to USD 9.9 billion in 2019 and expected to rise at a CAGR of 7.1% during the period from 2020-2027 [4]. A rise in the demand of enzymes was notified for application in paper processing, biofuels, biological detergents, cheese production, food processing, pre-digestion of baby foods, etc [5]. Today members of the genus Bacillus are involved in the production of different industrial enzymes that account for 50% of the total market value of enzymes that is around 1.6 billion dollars in 2013 [6]. But it has gained immense interest for its exorbitant energy input cost in large-scale product production while the industrial enzyme demand is in a sustained increase pushed by the increasing demand for sustainable alternatives and innovative biocatalysts. According to the reports released by Fior Market research, carbohydrase enzymes hold about 40% of market share in 2018 and bacterial enzymes were forecasted to develop at the maximum CAGR of 8.83%. The household care segment registered the highest percentage of 42.8% of market revenue in 2018. The increase in market share was due to the high usage of enzymes in cleaning detergents. Hydrolases are the most industrially utilized enzymes of all the enzyme types. Amylases are the most significant enzymes with immense relevance to biotechnology, and they account for 25% of the world enzyme market [11]. Alpha- and beta-amylase specifically have been the focus of special interest. Such hydrolyzing enzymes find a number of industrial uses like in food, textile, fermentation, detergents and paper industry.

3. MATERIALS AND METHODS

In most ecosystems, saprophytic fungi are key decomposer organisms. Although some species prefer substrates that originate from a specific plant species or plant tissue (i.e. leaves or wood), numerous fungal species are generalist saprobes. This indicates that there is a high level of functional redundancy among saprophytic aquatic fungi at spatial scales from submerged substrates to the entire ecosystem. Aquatic fungi are microscopic plants that communicate with other organisms and "individuals" at a microscopic level through enzymes and biochemical defense mechanisms. Thus, it can be predicted that resource partitioning by fungi will take place at the molecular level. This is substantiated by the thoroughly documented temporal succession that happens when fungi colonize an underwater leaf, and by the temporal partitioning of the resource implied. To utilize a substrate, fungi release extra-cellular enzymes that target and break down its chemical components [12]. Since distinct and independent enzymes or enzyme complexes are needed for the degradation of starches, cellulose, hemicellulose, pectin, proteins, lipids and lignin, the fungal genera, equipped with the set of enzymes capable of degrading most labile components of the leaf efficiently, emerge as the first colonizers [14]. When labile resources are exhausted, species capable of effectively breaking down the residual resources take over. Lignin-like complex plant material may be broken down by a series of enzymes excreted by several species of fungi and this is an illustration of resource partitioning at the sub-molecular level (lignin moieties) [16]. It is therefore probable that aquatic fungi biodiversity possesses inherent functional redundancy at larger scales, but at the molecular level, and over time there is inherent functional complementarily, competitive exclusion and partitioning of resources [7].

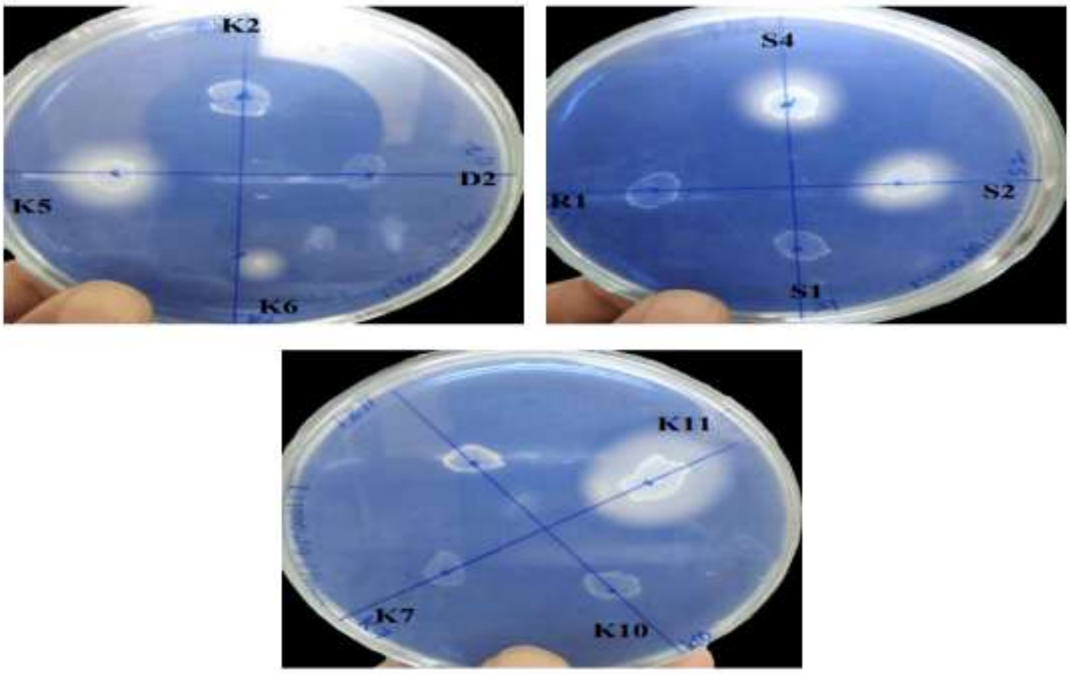

Figure 1: Screening of the isolates for the production of amylase enzyme

Enzymes are protein molecules that work by initiating chemical reactions in cells all over your body. Each molecule has its own unique shape and acts on only specific kinds of materials. Each enzyme has a specific sequence of proteins, and it is this sequence that decides its general activity within your body. Furthermore, an enzyme may have organic or inorganic non-protein material known as cofactors that determine its general shape and/or activity. Any given enzyme's shape enables it to bind up and change only one or two types of material in your body known as substrates during enzymatic reactions. Most often, an enzyme derives its name from the substrate type that it works upon. For instance, the enzyme sucrase converts the sugar sucrose into the sugars fructose and glucose. The enzyme lipase chemically converts the lipid or fat triglyceride.

4. RESULT AND DISCUSSION

Enzymes are significant biological catalysts which are essential requirements of all biological reaction in all living organisms on this planet [8]. For long times a chemical catalysts is utilized, although it's very commonly applied it was excessively inconvenient. The drawbacks of such methods like requirement of high pressure, temperature for catalyzing and the temperate specificity. This is all mitigated by the use of enzymes and hence operating in milder conditions compared to that crucial chemical catalyst for operation [15].

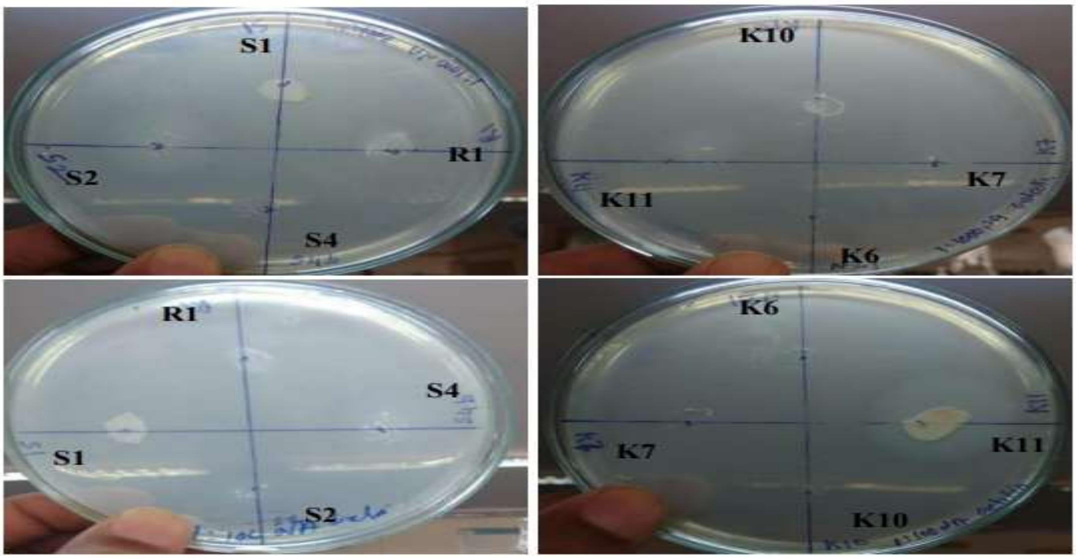

Figure 2: Screening of the isolates for the production of enzyme Gelatinase

Certain enzymes are employed as medicines and possess two significant characters which make them different from the rest of drugs. The first character of the enzymes is binding on specific target sites with immense affinity, specificity and secondly, they convert various targeted molecules into desired products as a catalyst. These two features of the enzyme make specified and strong drugs in therapeutics biochemistry in the body system and these feature leads to the developing of many enzymes drugs for various diseases.

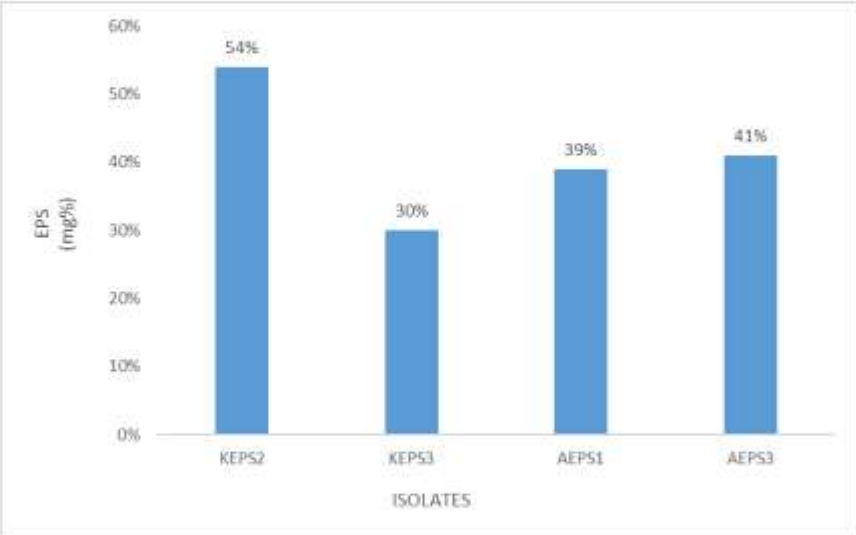

Figure 3: Isolates showing maximum EPS production by dry weight

As from ancient times yeast is predominantly employed for beer, bread, cheese, wine etc. production, the initial microscopic observation of microorganism and the account of the appearance of yeast noticed by Anotny van Leeuwenhoek in 1680.

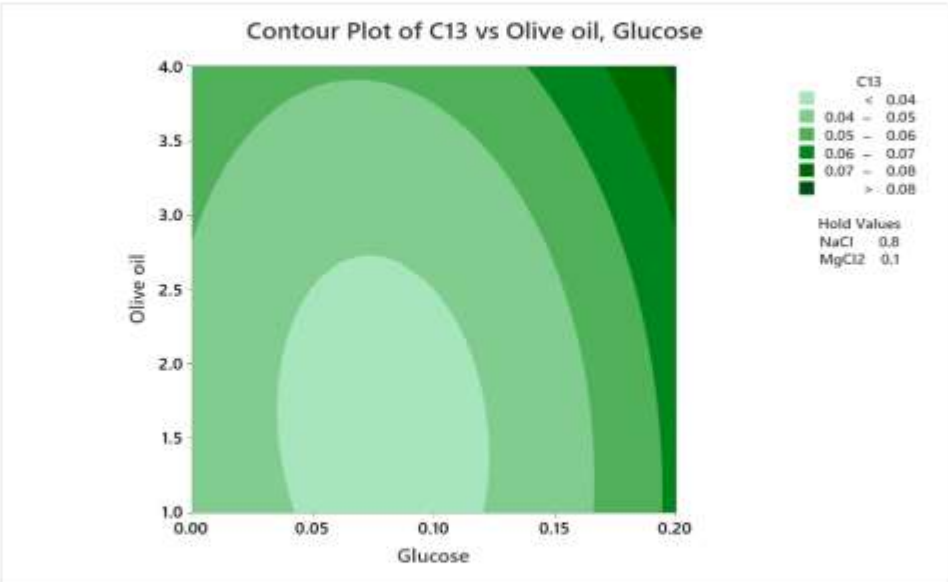

Figure 4.28: Contour plot of lipase activity Vs Olive oil and Glucose

French scientist Louis Pasteur found yeast's role in fermentation and pure culture (starter culture) of brewer's and wine yeast were acquired by Muller Thurgau and Hansen at the end of 19th century. As application of yeast starts in industrial fermentation not only in the food also drinks and various other broad range of products manufactured by yeast cells. The traditional fermentation process is performed by just the yeast species S.cerivisiae and it is believed that the yeast are fermentative, but this is opposite to common belief approximately around 50% of the species described not being able to ferment.

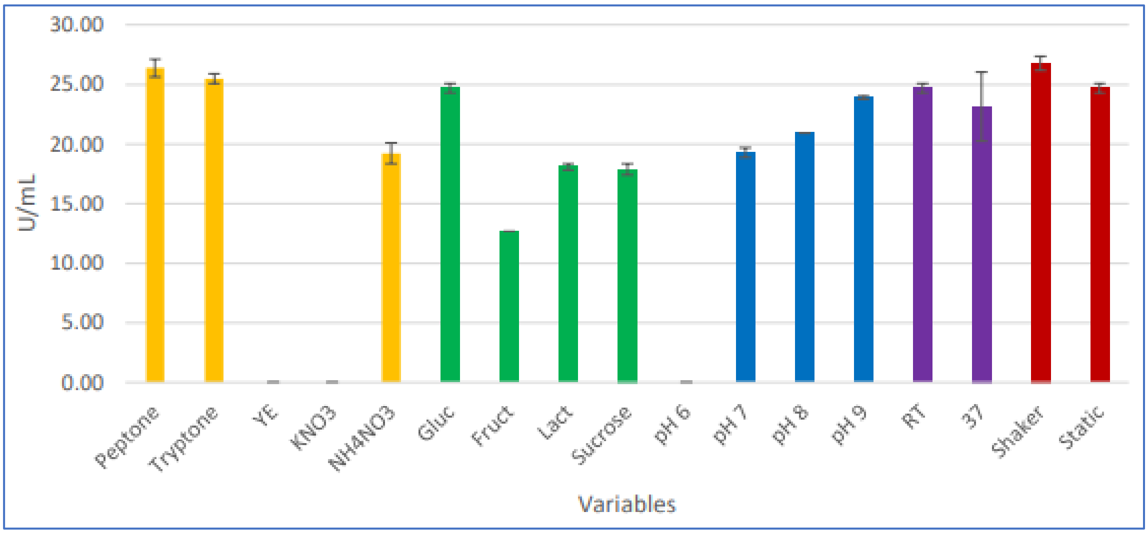

Figure 4: Media optimization for peroxidase using OVAT

A synthetic group of yeast fungi include unicellular, reproduces vagetatively by budding process and it could be differentiated either into Ascomycetes (e.g. Candida, Saccharomyces, etc.) or Basidiomycetes (e.g. Rhodotorula, Filobasidiella, etc.). Nearly 74,000 of fungi species including yeast species have been illustrated. The fungi biodiversity are richest the kingdom on the earth. The recent edition indicate that there are about 1500 known yeast species about and much higher particularly in the Basidiomycetous yeast number. Out of the yeast species, only about about a dozen utilized at industrial scale and 72 – 80 species demonstrated at laboratory scale to possess potential range in Biotechnology.

5. CONCLUSION

Enzymes are performing crucial function in the various industries. They are applied in food industry, paper industry, detergents industry, textile industry, pharmaceuticals industry, cosmetic industry and have been involved in various industrial applications. As from the ancient times enzymes have been utilized and they were utilized in, manufacture of beverages such as beer, wine, saccharification of starch, treatment of digestive disorders and production of cheese from milk. Among these enzymes αAmylase has been utilized extensively also in demand due to its key role in starch hydrolysis and use of such hydrolytic activity. Enzyme are playing the crucial role in wine production; it may be regarded as the resultant of enzymatic transformation of grape extracts. This enzymatic process not only came from the grapes also from the yeast and other microorganisms. Today the wine producers are complementing and augment their activity by these indigenous enzymes with the application of exogenous for commercial enzyme preparations. The production of extracellular hydrolytic enzymes from native yeast may be comparable and should be realized and well control for wine manufacturing advantageously. But the wine yeast is possible source for commercial production of enzymes and to be employed for the process of manufacture of wine.

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