Diversity and Enzymatic Activity of Fungi Isolated from the Mangroves of Makran Coast, Balochistan

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ABSTRACT

Introduction: At industrial scale, the production of microbial enzymes and their commercialization has gained a lot of focus and importance. Due to the enhancement in technology and developments, now microbes are used as bioreactors. Microorganisms are easy to grow on cheap media and the processes of production, recovery and purification of microbial enzymes are easy and convenient. About 80% of commercial enzymes are being produced from microbial sources. Mangroves are designating as the intertidal wetland ecosystem formed by the union of animals and plants. These wetland ecosystems are the most diverse and productive part in the world. More than 80% of marine life are directly or indirectly depends on mangrove and other coastal ecosystems worldwide. Mangrove forests contain trees, shrubs, palms, epiphytes, ground ferns and grasses. Mangroves are salt tolerant plants. Mangroves trees and shrubs belong to *Rhizophora* genus. Mangroves are usually present in tropical maritime and likely to survive in saline and brackish water. They naturally occur in sheltered coastal areas such as river mouths, tidal creeks, backwaters, lagoons, bays estuaries (where a river flows into a sea), marshes and mudflats of the tropical and subtropical latitudes (Sridhar 2004). About 97% of the mangroves found in Indus Delta while 3%, from total mangroves present in Pakistan, are available at Miani Hor, Kalmat Hor and Jiwani. These locations are found in Balochistan. The mangroves of the Balochistan have acquired little attention of ecologist. Miani Hor, Kalmat Khor and Gawatar Bay are three important small pockets of mangroves along the coast of Balochistan, which covers an area of 18,350 acres (Rasool and Saifullah 1996). Mangroves are regarded as a pool of bioresources (Sahoo, Dhal *et al*. 2014). Mangroves environment contain large variety of organisms including animals, plants as well as micro-organisms like bacteria, fungi, cyanobacteria, microalga, macroalga and fungus like protists that are able to produced industrially important enzymes like Cellulase, Lipase, Lactase, Laccase, Xylanase, Phytase, Protease, Peroxidase, Amylase, Pectinase, Insulinase, Catalase and many others. The reason behind the presence of myriads of microorganisms in mangrove marine environment, having huge industrial importance, is due to the availability of high and rich amount of particulate and dissolved organic matter in that environment (Velho and DeSouza 1982). Animals, microorganisms and plants are three different sources from which enzymes can be obtained. However, microorganisms are regarded as best source of commercial enzymes because limited enzymes production was reported from plants and animals (Volesky, Luong *et al*. 2008). Fungi are preferred among many other sources that produce enzymes. They are widely used for the production of industrial enzymes because they have excellent capacity for the production of extracellular proteins (Jun, Kieselbach *et al*. 2011). Mangroves forests are the biodiversity "hotspots" for marine fungi (Descals, Kohlmeyer *et al*. 2007). Mangrove fungi are the second largest group of organisms that are found in marine environment (Deshmukh and Gupta 2018). Different species of marine fungi have the ability to produce great variety of hydrolytic as well as oxidative enzymes that are used in biotechnological processes (Bongi-Santos, dos Santos Vasconcelos *et al*. 2015).

Aim: This study aimed to isolate fungi from mangroves of the Makran coast of Balochistan and to identify and screened them, for their ability to hydrolyze starch and pectin for the production of amylase and pectinase respectively.

Materials and Method: In this present investigation, mud, stem, leaves, bud, and muddy water mangrove samples were collected from different locations of Makran coast of Balochistan and were preserved in vials containing 30% glycerol as a preservative. By streaking the obtained mangrove samples on Yeast Peptone Dextrose (YPD) media plates, seventy-three different fungal strains out of hundred mangroves samples were revived. Mixed or different colonies were allowed to grow on separate YPD plates. The pure fungal cultures were identified on the basis of microscopic examination. All the strains were accessed for the production of extracellular enzymes, amylase and pectinase by plate assay method using starch and pectin as the substrate respectively. The development of a clear zone was regarded as a positive result for the enzyme activity of the respective mold.

Results: The present study revealed that 73% of fungal strains were revived out of hundred preserved samples and by separating mixed or different fungal colonies, total pure ninety-eight different fungal strains were obtained. The identified strains belonged to *Aspergillus, Cladophialophora, Cladosporium, Fusarium, Gliocladium, Mucor, Penicillium, Rhizopus, Trichothecium*. About 58% belonged to *Aspergillus* genus and 24% belonged to the *Mucor* genus while the rest of them belonged to different fungal genera. Out of ninety-eight pure fungal strains, 71% isolates were able to produce a significant amount of amylase from the hydrolysis of starch while 67% isolates were able to hydrolyze the pectin and showed pectinase production. Out of 98 fungal isolates, 51% of them showed both amylase and pectinase activity.

Conclusion: On the basis of this study, it has been concluded that variety of fungal species are present in the marine environment and these fungal species can degrade starch and pectin to produce industrially important enzymes, amylase and pectinase respectively that are widely used in textile, paper, pulp, food and in many other industries.

Keywords: Makran coast, Mangrove ecosystem, Marine fungi diversity, Microscopic examination, Substrate hydrolysis, Extracellular enzyme, Amylase, Pectinase.

REFERENCES

1. Bonugli-Santos, R. C., *et al*. (2015). "Marine-derived fungi: diversity of enzymes and biotechnological applications." Frontiers in microbiology 6: 269.
2. Descals, E., *et al*. (2007). "Fungal biodiversity in aquatic habitats." Biodiversity and Conservation 16: 49-67.
3. Deshmukh, S. K. and M. K. Gupta (2018). "Mangrove-Associated Fungi: A Novel Source of Potential Anticancer Compounds." Journal of Fungi 4(3): 1-39.
4. Jun, H., *et al*. (2011). "Enzyme production by filamentous fungi: analysis of the secretome of Trichoderma reesei grown on unconventional carbon source." Microbial cell factories 10: 68-68.
5. Rasool, F. and S. Saifullah (1996). "Mangroves of Kalmat Khor, Balochistan." Pakistan Journal of Botany 28(2): 143-150.
6. Sahoo, K., *et al*. (2014). "Production of amylase enzyme from mangrove fungal isolates." African Journal of Biotechnology 13(46): 4338-4346.
7. Sridhar, K. (2004). "Mangrove fungi in India." Current Science 86(12): 1586-1587.
8. Velho, S. and J. DeSouza (1982). "Studies on pectinolytic fungi from the mangrove sediments." Mahasagar 15(3): 167-173.
9. Volesky, B., *et al*. (2008). "Microbial Enzymes: Production, Purification, and Isolation." Critical Reviews in Biotechnology 2(2): 119-146.