Sustainable Management of Keratin Waste By Keratinophilic Fungi

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Abstract- *Keratin is a durable, insoluble, fibrous protein. Keratin present in higher vertebrates (mammals, birds and reptiles). Keratin doesn't degrade because of the tight packing of their polypeptide chains in alpha-helix structures and their linkage by disulphide bridges. Food industry especially the meat market, poultry farms, slaughter house and wool industries produces million of tons of keratin waste. Literature survey revealed that keratin waste increase environmental pollution, leading to the deterioration of a valuable resource and decrease species diversity, acidification of soils etc. In nature for overcome these problem keratinophilic fungi play an important ecological role in decomposing keratin material. Keratinophilic fungi produce Keratinase enzyme that digest keratin. For the study of these fungi the soil samples were collected from different animal habitat in Ajmer district. Present results show the keratinophilic fungi may have the significant role in keratin degradation in the environment and after recycle of keratin waste produce Keratinase can be used in feed industry, cosmetics and medicine industry.*

Keywords- Keratin waste, environmental pollution, keratinophilic fungi, waste sustainable management, Keratinase.

I. INTRODUCTION

Keratin substances which are important natural material is a fibrous protein and forming the main structural constituent of hairs, nails, skin, feathers, hoofs, claws, horns etc. Keratin is mechanically hard, chemically unreactive and insoluble in water and organic solvents and highly resistance to hydrolysis by week acids, ethanol or salt solution and also to enzymatic digestion. Keratin monomers assemble into bundles to form intermediate filaments, which are tough and form strong unmineralized epidermal appendages found in reptiles, birds, amphibians and mammals. Keratinous materials have high protein and are hardly digestible because of the high degree of cross-linkages by disulfide and hydrogen bonds. It also contains a variety of amino acids. Keratins have been classified into alpha- keratin (soft keratin e.g. hairs and wool) and beta-keratin (hard keratin e.g. beta sheets of feather). Keratin is abundantly available as a byproduct from poultry, slaughter house, tanning and fur processing industries. With developing Urbanization, food industries especially meat market, slaughter house, poultry farms and wool industry produces million tons of keratin waste. Due to enzymatic undigested nature and stability of keratin very few organisms are able to break it down and utilize it so their disposal leads to environmental problems such as air, soil and water pollution. The present study shows that keratinophilic fungi have been isolated from soil, where they are colonize various keratinous substrates, degrade them. Keratinophilic fungi are an ecologically important group of fungi and play significant ecologically role in decomposing keratin containing wastes such as hair, fur, nail and feather. These fungi produce Keratinases enzymes. Keratinases are proteolytic enzymes that degrade keratin.

II. KERATIN WASTE IMPACT ON ENVIRONMENT

Keratin is considerable major animal product such as feathers, hairs, nails, hoof, claws, skin etc. With developing urbanization, food industries especially the meat market, slaughter house, poultry farms and wool industry produces million of tons of keratin waste. Keratins are difficult to degradation and their disposal leads to environmental issues. Globally chicken feathers are the most common keratin waste produced high amounts in poultry slaughter houses. Around 24 billion chickens per year are killed across the world which is discarding four billion pounds of poultry feathers. These large amounts of discarded feathers are polluting the soil or air. The disposal of this waste is a global environmental issue leading to all types of pollution. The human need of chicken, wool, fish, birds, and reptiles in the food produce mammoth size of keratin waste. These wastes accumulated in ecosystem and causing water and soil pollution and adversely affect the life of people living in the nearby locality.

III. DEGRADATION OF KERATIN WASTE

Keratin, which is not easily degradable by common proteolytic enzymes. It degrade by special type of enzyme are called ''Keratinase'' enzyme. Keratinase are proteolytic enzyme that digests keratin. Diverse group of micro organisms are reported to produce Keratinase like fungi (keratinophilic fungi) and bacteria. The keratinophilic fungi play significant

role in the degradation of keratin waste. Keratinophilic fungi have been frequently isolated from, where they are colonize various keratinous materials degrade them and to the mineral content in the soil.

IV. Material and Methods

1. Collection of soil samples:

Thirty six soil samples were collected randomly from different animal habitat in the Ajmer District. Before collection of soil samples, superficial debris was removed from soil surface. Loosened soil (approximately 500g) has taken from the surface layer of each site to a depth of 2-5cm. Soils were collected in sterile plastic bags and sealed on the spot. Samples were brought to the laboratory and used immediately or stored overnight.

2. Isolation and Identification of keratinophilic fungi:

Keratinophilic fungi were isolated from different soils samples using ''**Hair Baiting technique**'' (Vanbreuseghem 1952). The soil samples and moistened with sterile distilled water are baited by burying sterile keratinous baiting the soil. These dishes were incubated at room temperature (Period of 4 weeks).

V. RESULT AND DISCUSSION

Keratinophilic fungi have been frequently isolated from soil samples collected from various sites of Ajmer district. Keratinophilic fungi have ability to degrade keratin to components of low molecular weight. These fungi produce Keratinase enzyme that degrade keratin. These fungi are present in the environment which depends on various factors such as human and animal presence. Keratinophilic fungi belongs two groups deuteromycetes and ascomycetes. The species of keratinophilic fungi have been divided into three categories depending on their natural habitat:

1. Anthrophilic :- When human beings are natural host.
2. Zoophilic :- when animal act as natural host.
3. Geophilic:-when they inhibit soil.


A. Degradation of human hair


B. degradation of cow hair

VI. RECYCLE OF KERATIN WASTE

Keratin materials have high protein content, consisting of at least 17 amino acids which can be used for purposes such as nutrition in animal feed or fertilizers, medicines and cosmetics. Only Keratinase have capability to degrade insoluble keratin materials. Many kinds of microorganism are reported to produce Keratinase enzyme. In the feed industry, the main component of feathers is keratin, which has crude protein content a complete range of essential amino acids which is good source of feed protein. In agriculture, keratinase produce by Keratinolytic microorganisms can degrade keratin waste into polypeptides and amino acids, which can be used to make organic fertilizers. These kinds of fertilizers can solve the problem shortage energy and also degrades the source of pollution. Keratinase can also use be used in cosmetics and medicine industry.

VII. CONCLUSION

The purpose of this research was to study the impact of keratin waste on the environment and how can insoluble, indigestible keratin waste degrade in the environment. After observation this research suggests that the keratin waste is not easily degradable in the environment. Each year food industries especially poultry farms, slaughter houses and wool industries produce mammoth size of keratin waste. Due to stability of keratin each year the large amount of keratin waste accumulated in the ecosystem and lead to environmental problems. Only Keratinase enzymes have capability to degrade keratin materials. The present study shows that Keratinolytic microorganisms have ability to produce Keratinase enzyme. So these micro organism have great importance in degradation of keratin waste and its use for improvement of livestock feed and production of fertilizers, medicines and cosmetics.

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