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REVIEW ARTICLE

Keratinophilic Fungi from Bottom Sediments: A Review

R K S Kushwaha

Shri Shakti College, Harbaspur, Ghatampur, Kanpur-209 206, India
Email: kushwaharks@gmail.com

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ABSTRACT

Recent attention of keratinophilic fungi from diverse habitats of the world attracted workers to find out their potential to produce various extracellular metabolites. Also their potential to degrade keratin waste in bottom sediments seems to be of immense importance ecologically. In view of this an attempt is made to compile available work on keratinophilic fungi particularly from bottom sediments.

Key words: keratinophilic, fungi, sediments.

INTRODUCTION

Keratinolytic fungi constitute an important ecological group of microbes which are able to colonize and degrade structurally very hard and stable animal protein the keratin, millions of tones of which deposited on this planet every year by reptiles, birds and mammals. In natural environment, therefore keratinolytic fungi are involved in recycling the carbon, nitrogen and sulphur in keratins. Their presence and distribution seem to depend largely on the amount of keratinic material available due either to man or to domestic animals, synanthropic and wild animals especially where human and animal populations exert strong selective pressure on the environment. Keratinophilic fungi and related dermatophytes colonize natural keratin baits in well known [110]. The prevalence of these fungi and their ecological status in India soil is poorly documented owing to incomplete studies of the keratinophilic fungal flora [75-109]. In superficial waters keratinophilic fungi occur frequently or accidentally. The process of succession of fungi colonizing keratin may differ in various habitats. Mostly keratinomycetes survive in soil rich in keratinous substrates [111-119]. Their worldwide presence invited their search in unexploited habitats. Their presence in submerged sediments in India have not received attention however their presence in bottom sediments of Poland and Spain was ascertained [191-219].

The distribution of keratinophilic fungi in Indian soil has been studied by several workers but the bottom sediments area is neglected. In abroad some investigations have paid special attention for examining the occurrence of keratinolytic fungi in habitats. These fungi have been found to colonize both dry and moist salty environment [1-4]. However no strong effect of marine salinity and their survival in vitro has been demonstrated. Some studies of marine habitats, particularly sediments of the Mediterranean sea have displayed little or no keratinolytic fungi. There are other studies on keratinolytic fungi in fresh water and sewage environments [5-74]. In addition experiments of determine the long and short term survival of certain pathogenic keratinolytic fungi in fresh water and sewage habitats also been performed [152-154]. Since the aquatic habitats of India are not investigated for these fungi it is therefore, a present proposal is undertaken to study fungal diversity, influence of different factors on growth and keratin degradation in these habitats.

Due to high micro- and macro-element contents sewage sludge is often used for reclamation of agricultural, forest and devastated soils. However, sludges also contain many harmful chemicals, e.g., heavy metals and PAHs and pathogenic organisms. Therefore, each time sludge land use must be preceded with sanitary analyses and health risk evaluation. The occurrence and survival of bacteria, viruses, protozoa and helminths in sewage sludge have been relatively well recognized [1, 2]. Still little is known on

***Corresponding Author:** Dr R K S Kushwaha, **Email:** kushwaharks@gmail.com

pathogenic fungi in the sludge environment [1, 3, 4]. Due to high quantities of keratinous debris of human and animal origin (mostly hair), this environment should especially favor the growth of keratinolytic and keratinophilic fungi. Vanbreuseghem's hair baiting method has been mainly used for examination of keratinolytic and keratinophilic fungi in sewage sludge and other organic waste and waste-contaminated habitats

Little information is available on the occurrence of these fungi in waste and waste-contaminated habitats. Several workers [1,2,8,11,13,20] have studied sewage and freshwater habitats. Indoor and outdoor dust within urban agglomerations has been surveyed for keratinolytic fungi and related species several times [1,20-151,155,158,158,161-190]. However, no data have been found on the occurrence of these fungi in municipal solid waste, including street sweepings (dust), and soil contaminated with municipal solid waste at urban areas, transfer stations and landfills.

In superficial waters, keratinolytic fungi occur infrequently or even accidentally. It appears that there are no clear relationships between the occurrence of these microorganisms and the degree of sewage contamination in the waters. By contrast, keratinolytic fungi occur abundantly in sediments of the waters. Some earlier studies have already allowed determining general relationships between the qualitative and quantitative composition of these fungi in sediments and the classes of sewage contamination in the waters [159-160]. The classes included both bacterial (fecal) and chemical contaminants. *Microsporum gypseum* and other species from the genus as well as *Myceliophthora vellerea* mainly occurred in sediments of very badly polluted (classless) waters. The incidence of *Trichophyton ajelloi*, *Chrysosporium keratinophilum*, *Geomyces pannorum* and some other species increased with increasing water pollution. The incidence of *Aphanoascus fulvescens*, *A. reticulisporus* and *Chrysosporium pannicola* was the highest in sediments from 3rd class waters. It was also found that *Chrysosporium europae* was associated with slightly polluted waters. The incidence of *Aphanoascus terreus* (anamorph *Chrysosporium indicum*) and *Chrysosporium* anamorph of *Arthroderma curreyi* in sediments bore little relationship to levels of sewage contamination in the waters. Finally, the incidence of *Trichophyton terrestre* with its teleomorph *Arthroderma quadrifidum* were the highest in sediments from unpolluted and only slightly polluted waters. The incidence of *Arthroderma quadrifidum* and *A. uncinatum* (with their anamorphs) were much higher in Silesian sediments while a higher incidence of *Aphanoascus fulvescens*, *A. reticulisporus*, *Chrysosporium* anamorph of *Arthroderma curreyi* and *C. tropicum* was observed in Catalonian sediments. Another difference between the sediments is that among the *Aphanoascus* species *A. reticulisporus* predominated in Silesian sediments whereas *A. fulvescens* prevailed in Catalonian sediments. In both studies, however, strains with intermediary characteristics were found [191,192]. The conclusion is that the differences in fungal compositions resulted from the differences in climatic conditions (mainly temperature) between both countries. The studies have demonstrated that both water contaminants and natural factors such as temperature, solar radiation and salinity influence the compositions of keratinolytic fungi in sediments. The diversities of keratinolytic fungal communities increased to a certain level of water contamination but decreased in badly contaminated waters.

In the hair baiting method, *Chrysosporium keratinophilum*, *Aphanoascus reticulisporus*, *A. fulvescens*, *Trichophyton ajelloi* and some other species correlated well with the factors. In the actidione plating method, the association of *Narasimhella marginospora* with badly polluted Catalonian waters is unquestionable. Recent studies have concerned the occurrence of keratinolytic fungi in mountain sediments. In sediments from mountain streams in Brenna, the influence of water contaminated by sewage on a keratinolytic fungal community was observed [41]. The changes in the diversity of the community depended on the organic matter content, the concentrations of salts and the particle size distribution. The impact of local climatic conditions on the composition of keratinolytic fungi in the sediments was also demonstrated. Apart from the mesophilic *Microsporum gypseum*, a rare psychrophilic dermatophyte, *Keratinophyton ceretanicus*, occurred abundantly in mountain sediments. The fungus specializes in the decomposition of keratin remnants under severe mountain conditions. At room temperature, geophilic dermatophytes, i.e., *Trichophyton ajelloi*, *T. terrestre* and *Microsporum gypseum* (with their teleomorphs) prevailed in the samples. At higher temperatures, the dermatophytes were observed sporadically and *Chrysosporium*

keratinophilum together with *Aphanoascus reticulisporus* predominated on hair bait.

The abundance of keratinolytic soil fungi on hair bait can result not only from the assemblance of fungal propagules in sediments but also from the certain behavior of these fungi in the aqueous environment. It appears that keratinolytic fungi could also be indicative microorganisms. The most important factors are delivery and congregation of keratin remnants and fungal propagules together with the decomposition of the remnants in a given environment; level of environmental pollution with human and animal feces; physico-chemical factors, including climatic conditions; presence of toxic compounds and elements of industrial and natural origin in the environment [156,157].

These fungi commonly occur within highly populated areas to which keratin remnants are continuously delivered. In unpopulated areas, the abundance of keratinolytic fungi is restricted mostly to fields treated with organic fertilizers and to the places constantly or temporarily penetrated by animals [220,224]. However, in sewage and municipal waste extremely high amounts of keratin remnants and other compounds needed for fungal growth are expected. In fact, large keratin particles were clearly observed on sieve nets during the sieving of sludge samples.

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