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Rift valley soda lakes enzymes and their application in novel leather processing technology for next-generation tanneries

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Abstract

Leather manufacturing involves conversion of raw skin and hides into leather (stable material) through series of mechanical and chemical operations. The leather industry has attracted public outcry due to severe environmental degradation, pollution and health and safety risks. Currently the industry faces serious sustainability challenge due to extensive use of toxic chemicals and generation of hazardous waste.

In order to overcome the hazards caused by toxic chemicals in tanneries and protect the environment, enzymes from microorganisms from Rift Valley Soda Lakes have been identified as a realistic alternate for chemicals used in beam house operation and waste management. In this study introduces a novel leather de-hairing process using enzymes as opposed to the traditional de-hairing process which utilizes chemicals toxic to the environment. Furthermore, the study also shows recovery methods for adding value to the side and waste streams of the leather industry, targeting “zero” waste discharge. Alkaline active proteases of alkaliphiles offer advantages over the use of conventional chemical catalysts for numerous reasons, for example, they exhibit high catalytic activity and high degree of substrate specificity, can be produced in large amounts and are economically viable. This is because the enzymes of these alkaliphiles are capable of catalysing reactions at the extremes of pH, temperature and salinity of leather-manufacturing processes.

We describe how alkaliphilic enzyme can effectively be used in soaking, dehairing, bating and degreasing operations to prevent waste generation, help in recovery of valuable by-products, reduce cost and increase leather quality. It is worth noting that alkaliphilic enzymes were shown to be capable of replacing sodium sulphide in the dehairing process. In addition, alkaline proteases showed remarkable ability in bioremediation of waste generated during the industrial processes. Intensive efforts are being directed towards chemical-based industries to use viable clean technology in their operation to reduce their negative impact on the environment. We recommend, leather industry should adopt the use of eco-friendly reagents such as enzymes to achieve long-term sustainability and clean environment and avert health hazards. Application of enzyme technology in clean leather processing strongly depends on legislation, political will and allocation of financial resources in research, development and implementation of this potentially powerful technology.

Comprehensive audit of quantities and chemical analysis of the waste streams recovered from the eco-friendly leather processing provides insightful information on recommendations on how to create new values chains from the tannery wastes and alternative utilization of the wastes. Great milestone achieved with respect to mutual trust and commitment to deliver, between University and Leather Industries.

Biography

Francis J Mulaa is Associate Professor of Biochemistry in Biochemistry Department of University of Nairobi. He has completed his Ph.D. in Departmenment of Biochemistry in 1990 from the Obafemi Awolowo University, ILE-IFE, Nigeria. He did double MSc. In Department of Biochemistry from University of Nairobi, Kenya in 1986 and Faculty of Chemistry Donestk State University, USSR in 1983. He has Language certificates from Varonezh State University, USSR, 1977 Preparatory Faculty. He has earned many awards and honor in Biochemistry.

Publications

1. Publication I: Alkaliphilic Enzymes and Their Application in Novel Leather Processing Technology for Next-Generation Tanneries
2. Publication II: Effective biotransformation of Reactive Black 5 Dye Using Crude Protease from Bacillus Cereus Strain KM201428
3. Publication III: In Silico Approaches for Drug Design and Discovery: The 18s Ribosomal RNA of the Zoonotic Parasite Cryptosporidium Parvum as a Drug Target
4. Publication IV: Protease-, Pectinase- and Amylase- Producing Bacteria from a Kenyan Soda Lake
5. Publication V: Extraction and characterization of gelatin from Lates niloticus and potential industrial applications

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