

Isolation, characterization and optimization of keratinolytic bacteria from chicken feather waste dumping site

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ABSTRACT

Chicken feathers are considered to be the waste products of poultry industry and can create a solid waste problem in the environment. Keratinases have the potential to degrade insoluble keratin predominantly present in feathers, hair, horns, and hooves. The aim of present study is to isolate, screen, and identify keratinolytic bacteria from feather waste dumping site and to optimize the culture conditions for maximum keratinase production and subsequent degradation of feathers. Fourteen bacteria were isolated from the feather waste dumping site at Virudhunagar, Tamil Nadu, India, and were screened for their keratinolytic property. Comparatively, three bacteria displayed better keratinolytic activity. Based on morphological and biochemical characteristics and 16S rRNA gene sequence analysis, they were identified as *Bacillus licheniformis*, *Glutamicibacter arilantensis*, and *Serratia marcescens*, respectively. The effect of temperature, pH, feather concentration, and various substrates on the growth parameters of these bacteria was studied. The growth and protein production was high at 40°C for all bacteria. *B. licheniformis* and *S. marcescens* produced more protein at pH 8.5, whereas *G. arilantensis* produced more protein and grown well at pH 8. Hence, these three bacteria were subjected to submerged fermentation using chicken feather powder (1%) as Carbon and Nitrogen sources. Among them, *G. arilantensis* is the superior in degrading feathers producing more protein (2.15 ± 0.04 mg/ml) and amino acids (0.498 ± 0.019 µg/ml). The microscopically observed smears of feather hydrolysates revealed that *G. arilantensis* degraded the chicken feathers more efficient comparatively other two bacteria.

1. INTRODUCTION

The poultry industries largely satisfy the ever increasing animal protein demand globally that has arisen due to population explosion [1]. People consume large quantity of chicken meat, consequently leads to the enormous generation of slaughterhouse waste [2]. Globally, 8.5 billion tons of poultry feather waste has been produced annually. In 2018, India produced 4.6 million tons of broiler chicken [3] and approximately 350 million tons of feather waste generated every year [4] and the feathers are indiscriminately dumped into the environment [5]. The accumulation of feathers in the environment leads to a variety of human ailments including cholera, fowl cholera, mycoplasmosis, and the outbreaks of H5N1 virus [6,7]. More than 90% of feathers are composed of protein and the major one is keratin. Extensive disulfide bonds and cross-linkages make keratin rigid and insoluble in water. Based on the sulfur content, keratins are classified as: hard keratins (feather, hair, hoof, and nail) and soft keratins (skin and callus) [8]. Sulfur content in keratin is high due to the presence of sulfur containing aminoacids such as cystine, cysteine, and methionine [9,10]. Keratin is remarkably resistant to degradation

by regular proteolytic enzymes such as pepsin, papin, and trypsin. Nevertheless, feathers are considered as a good source of protein and essential amino acids if systematically recycled [11].

Various strategies have been adapted to manage the slaughterhouse waste generated in India. However, feather waste still remains a challenge [12,13].

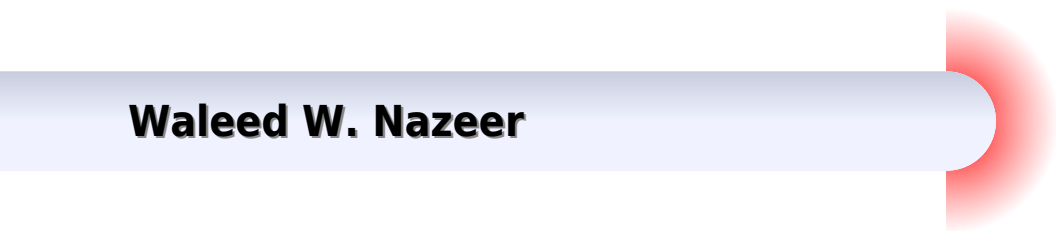
Conventional methods of feather degradation such as acid/alkali hydrolysis and steam pressure cooking destroy the heat sensitive essential amino acids such as lysine, methionine, and tryptophan and generate non-nutritive amino acids apart from consuming huge amount of energy [14-16]. Land dumping and incineration methods are likely to result in environmental destruction and generates highly toxic emissions [17]. The conventional method of processing feather waste is cost and labor intensive that may reduce the nutritive value. Protease is used for hydrolysis of the peptide bonds that link amino acids together in a polypeptide chain [18,19]. The enzyme-catalyzed reaction is cost effective, highly efficient, and easily selective which usually requires mild reaction conditions and less energy which consequently improves the value of feathers [20]. A group of secreted proteolytic enzymes called as keratinases have the ability to hydrolyze insoluble keratins more efficiently than other proteases, are produced by microorganisms and some insects [21]. Hence, the alternative method of using microorganisms and their enzymes in

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Isolation Of Keratinolytic Bacteria From Feather Dumping

Waleed W. Nazeer



Isolation Of Keratinolytic Bacteria From Feather Dumping:

Keratin as a Protein Biopolymer Swati Sharma,Ashok Kumar,2018-11-23 This book provides information about the sources structure and properties of keratin as well as its applications The extraction from different biomass sources e g feathers hairs nails horn hoof and claws as well as the characterization methods of these extracted materials are explained The development of bioproducts from keratins is challenging and limited since they are neither soluble in polar solvents nor in non polar solvents Therefore the utilization of different microorganisms for the degradation of keratin is also discussed The main aim of this book is to highlight the unique features of keratin and to update readers with the possible prospects to develop various value added products from keratins The book is highly interesting to researchers working in industry and academia on bioproducts tissue engineering biocomposites biofilm and biofibers **Biomass, Biofuels, Biochemicals** Ram Sarup Singh,Reeta Rani Singhania,Ashok Pandey,Christian Larroche,2019-01-31 Biomass Biofuels and Biochemicals *Advances in Enzyme Technology* provides state of the art information on the fundamental aspects and current perspectives in enzyme technology to graduate students postgraduates and researchers working in industry and academia The book provides information about the use of enzyme technology as an important tool for biotechnological processes including food feed fuels textiles paper energy and environmental applications The search for improvements in existing enzyme catalyzed processes dictates the need to update information on various enzyme technologies The book gives a snapshot of current practice and research in the area of enzyme technology Includes current and emerging technologies for the development of novel enzyme catalysis Outlines immobilized enzymes and their implications Refers to enzymes as diagnostic tools Includes metabolic engineering principles for improving industrial enzymes *Sustainable Microbial Technologies for Valorization of Agro-Industrial Wastes* Jitendra Kumar Saini,Surender Singh,Lata Nain,2022-09-30 This book provides an overview of the different aspects of microbial bioconversion methodologies for valorization of underutilized wastes of varied nature It covers microbiological biotechnological aspects environmental concerns bioprocess development scale up aspects challenges and opportunities in microbial valorization at commercial scale It explains sustainable microbiological processes for bioconversion and valorization of the wastes for production of various products of commercial interests including biofuels bioenergy and other platform chemicals The book presents potential biotechnological topics and strategies for the valuation of agricultural waste materials provides technical concepts on the production of various commercially significant bioproducts introduces various microbial bioprocesses to sustainably valorize various potential wastes as renewable feedstocks for production of biofuels and biochemicals explores the relevant scale up opportunities commercialization aspects and critical technological advances and explains concepts and recent trends in life cycle analyses in waste valorization It is aimed at researchers and graduate students in bioengineering biochemical engineering microbial technology microbiology environmental engineering and biotechnology *Microbial Niche Nexus Sustaining Environmental Biological Wastewater*

and Water-Energy-Environment Nexus Senthilkumar Kandasamy, Maulin P Shah, Kavitha Subbiah, Naveenkumar Manickam, 2025-01-15 In most of the industries industrial effluent treatment plants are playing vital roles to ensure the efficient management of industrial effluent for supporting sustainable development of our society Due to the technological development new concepts about future wastewater management are being incorporated by process industries in the whole world including recyclable resources and energy nutrient recovery from industrial effluent etc However conventional treatment methods including biotechnological methods used in treatment plants are facing a lot of difficulties due to the strict discharging norms and coming out of new fangled pollutants Recently a novel concept microbial niche nexus sustaining biological wastewater treatment was introduced which can accomplish the significant removal of toxic emerging pollutants by different microbial communities with the concern of other components like integrated and healthy ecosystem The book focuses on research related to future potential and progress of microbial niche based environmental biotechnology such as microbial enrichment microbial function system design new technological developments and its applications Besides the book reviews important interconnections between water energy and the environment as security in water and energy and the environment is associated with human beings natural resources economic and environmental sustainability In addition the book describes innovative green technologies with the aim of enhancing the present state of the art technologies in the various fields like water energy the environment and the related potential fields of industrial wastewater treatment The Green Revolution: Building Sustainable Solutions Kumud Kant Awasthi, Subodh Srivastava, Sushila Rathore, 2025-11-01 This book showcases some of the research that was presented at the RTESD 2023 the 3rd international conference on recent trends in environment and sustainable development with topics that explore important global issues This book covers cutting edge research and creative solutions in four key areas nanomaterials in biological applications renewable energy agrifood and sustainability Discussions about environment protection cover a wide range of topics including how to manage environment resources sustainably how to improve governance and the effects of climate change Chapters on energy production urban and industrial systems governance issues and the crucial shift towards circular economies are all included in the section on energy The Agrifood domain looks into innovative food processing techniques the impact of climate change on food production and sustainable agricultural practises As a final note the Sustainability segment covers a wide range of subjects including the sustainability of the bioeconomy cyber physical systems the effects of climate change and resource efficiency supporting the urgent need for a comprehensive strategy for achieving global sustainability Fungal Resources for Sustainable Economy Ishwar Singh, Vijay Rani Rajpal, Shrishail S. Navi, 2023-04-07 This edited book provides a comprehensive account of the new developments in various facets of fungal biology related to the impact and application of fungi on the sustainable economy The book consists of 24 chapters distributed under five sections written by active researchers and academicians from India and abroad The five sections of the book are 1 Fungi in Sustainable Economy 2

Fungal Resources Current and Potential Industrial Applications 3 Fungal Resources Current and Potential Agricultural Applications 4 Fungi and their Secondary metabolites Implications and 5 Fungi Burden to health and Indoor Environment The book explores the utility of fungi as food enzymes organic compounds nutraceuticals pharmaceuticals and agricultural productivity promoter It also highlights the negative fungal impacts on food production health and environment The book is useful to postgraduate students studying mycology plant pathology crop protection agricultural sciences and plant sciences In addition scientists involved in biological and agricultural research crop management and various industries that manufacture or utilize fungal products on a small to large scale shall also find the book helpful *Novel Enzyme and Whole-Cell Biocatalysts* Anwar Sunna, Richard Daniellou, 2020-11-04 The concept of a circular economy relies on waste reduction valorization and recycling Global trends for green synthesis of chemicals have positioned the field of enzyme technology and biocatalysis multi enzymes and whole cells as an alternative for the synthesis of more social and environmentally responsible bio based chemicals Recent advances in synthetic biology computational tools and metabolic engineering have supported the discovery of new enzymes and the rational design of whole cell biocatalysts In this book we highlight these current advances in the field of biocatalysis with special emphasis on novel enzymes and whole cell biocatalysts for applications in several industrial biotechnological applications **Isolation Optimization & Characterization Of Keratinolytic Bacteria** Nudrat Baqri, Mehwish Iqtedar, Shagufta Naz, 2013 A major by product of poultry industry is waste feathers The huge increase in size of individual production facilities and the total poultry industry has resulted in enormous increases in waste particularly feathers to be managed Feather waste is produced in massive amount resulting in large quantities of this byproduct of poultry industry Feathers constitute over 90% protein the main component being beta keratin a fibrous and insoluble structural protein extensively cross linked by disulfide bonds Keratin is resistant to digestion by animals insects and proteases leading to serious disposal problems In the present study two feather degrading bacterial strains S1 and D1 were isolated from poultry waste Considering their keratinolytic nature these isolate could be a potential candidate for feather protein degradation and utilization Instead of other non eco friendly means of feather hydrolysis use of these keratinolytic bacteria for feather degradation is an economical environmental friendly alternative Keratinases produced by these bacteria can be used in industries such as leather textile and animal feed

Isolation of keratin degrading microorganisms from poultry waste: an overview Prem Jose Vazhacharickal, John Joseph, Aswathi M.V, 2018-04-14 Keratin is an insoluble protein macromolecule with high stability and low degradation rate the keratinase enzyme degrade keratin the present study deals with isolation and identification and optimization of feather degrading bacterium After the identification analyzed the keratin degradation by crushed feather as a substrate of the media The colony showed were keratinase production was identifies as *Bacillus* sp as per Bergey's manual method The isolated organism shows keratin degrading property The maximum degrading property shows at pH 9 The minimum degrading

activity shows at pH 6 Biodegradation of Chicken Feathers by Keratinolytic Fungi Elhagag A. Hassan, Magdy M.K. Bagy, Fatthy M. Morsy, 2013 Feathers are discarded in large quantities at industrial poultry processing plants as a waste by product leading to environmental pollution Because of the insoluble nature of keratin and its resistance to enzymatic digestion by animal plant and many known microbial proteases use of feathers as a source of value added products has been very limited Most feather wastes however is land filled or burned which involves expenses and cause environmental problems Traditional methods such as steam and pressure and strong alkali or acid usually used in processing feathers required significant energy and resulted in destruction of some essential amino acids Microbial degradation of feathers may provide a viable alternative for improving feathers utilization because it is ecologically safe low cost and offers mild reaction conditions In an attempt to resolve this dilemma fungal degradation of feather may overwhelm these problems and provide available alternative for improving feathers utilization **Biodegradation of Chicken Feather by Some Keratinolytic Fungi** Waleed W. Nazeer, 2017-01-31 Screening of Keratinolytic Bacteria from Poultry Waste Suneetha Vuppu, 2011-05 Prof Suneetha has completed Doctoral degree in Microbial Technology and Bioprocess engineering She has Been awarded Young scientist from DST Collaborative research with UK and Russia Her areas of Research are Microbial enzymes Microbial products and Fermentation and Environmental biotechnology Bioremediation is a Recent Biotechnological solution for treatment of waste Poultry waste generated from industries is a big problem Hence this study gives some solution Whole chicken feather-degrading keratinolytic protease □ □ □ □ Bacillus subtilis SMMJ-2 □ □ □ □ □ □ □ □ , 2007

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