Chapter 1

Introduction

1.1 Background

Keratin is a fibrous structural protein that plays a crucial role in the composition of various biological materials, including hair, nails, feathers, and wool. Its unique properties, such as high biocompatibility and biodegradability, have led to significant interest in its applications across multiple fields, particularly in cosmetics and pharmaceuticals (Banasaz, 2024). Keratin-based materials can enhance cellular proliferation and migration, thus accelerating the repair process. In tissue engineering, keratin scaffolds provide a supportive environment for cell attachment and growth, facilitating the regeneration of damaged tissues (Banasaz, 2024).

Traditionally, keratin is extracted using methods such as acidic or alkaline hydrolysis, where keratin-rich materials like wool, feathers, or hair are treated with strong acids or bases to break down the protein structure. Alkaline hydrolysis is particularly common, as it involves soaking the keratin source in a basic solution at elevated temperatures, which facilitates the solubilization of keratin while maintaining its functional properties. One major downside is that these methods have significant environmental impact, causing toxic waste generation and water pollution (Chilakamarry, 2021). To tackle these issues, it is possible to use microbial fermentation using *Bacillus subtilis*, this microbe can naturally break down keratin through their enzymatic processes, minimizing the need for harmful chemicals. However, a significant limitation is that the yield and quality of keratin produced via this method are presently inferior to those obtained through hydrolysis extraction (Chilakamarry, 2021). Consequently, optimizing the fermentation conditions is essential to improve its efficiency and establish it as a feasible industrial alternative.

This study focuses on improving solid state fermentation (SSF) for keratin extraction by testing five *Bacillus subtilis* strains and varying inoculum Conditions (Macedo, 2005). SSF typically utilizes simple, inexpensive substrates and operates with minimal energy requirements for agitation and aeration, which reduces operational expenses. Additionally, SSF generates less wastewater and does not require extensive sterilization processes, leading to lower microbial contamination risks. This method also allows for the effective use of agro-industrial waste as substrates, contributing to environmental sustainability (Shi, 2021). The experiment will involve preparing chicken feather substrate and different growth conditions such as inoculation size and incubation period. Solid state fermentation will be conducted using five different strains with different growth conditions to assess their impact on keratinase activity which will then be measured by conducting a keratinase assay. This research can contribute to the development of eco keratin extraction, making it more competitive with traditional extraction methods.

1.2 Objective

Optimize the yield of keratin extracted from chicken feathers by evaluating the effect of different inoculum sizes in Solid State fermentation.

1.3 Hypothesis

H_0 (Null hypothesis)

- Varying amounts of *Bacillus subtilis* will not affect the degradation of keratin in solid state fermentation

H_1 (Alternate Hypothesis)

- Varying amounts of *Bacillus subtilis* will affect the degradation of keratin in solid state fermentation