KOCURIA ROSEA AS A NEW FEATHER DEGRADING BACTERIA

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Abstract

A strain of Kocuria rosea with keratinolytic activity was isolated. This Gram-positive coccus-shaped bacterium was able to degrade whole feathers in 72 h at 40°C. In batch culture, the optimum temperature for feather degradation, bacterial growth and protease secretion was 40°C. Under these conditions, biomass and caseinolytic activity reached 3.2 g/l and 0.15 U/ml, respectively, after 36 h incubation. Extracellular protease secretion was associated with the exponential growth phase. Feather degradation reached 51% in 72 h with a yield on biomass of 0.32 g/g. Enzymatic assay by polyacrylamide-gelatine gels showed two bands with alkaline proteolytic activities in the fermentation juice after 72 h of culture.

1. Introduction

The expansion of biotechnology has produced an increasing demand for high-quality inexpensive microbial growth media. Utilisation of feathers from the poultry processing industry as a substrate for fermentation might offer an inexpensive alternative for a microbial method of metabolite production, such as enzymes and unicellular protein can be achieved provided an efficient utilisation.

Feathers are a poultry by-product rich in protein (mainly keratin) and generated in very large quantities as a waste product from poultry processing industry. For many years, they have been the object of nutritional studies in order to incorporate them as nitrogen supplement in animal foodstuff. This allows poultry industry to take advantage of their usefulness and eliminates the environmental problem generated. In their native state, feathers have two important nutritional limitations: an amino acid imbalance and a poor digestibility (Xiang Lin et al. 1992).

Industrially, a great part of the feather waste is cooked under high pressure and temperature producing a feather meal, which can be incorporated into poultry foodstuff as a protein supplement. This product has been evaluated extensively and the results...
show that it is not very digestible and the destruction of certain amino acids during the process, such as cysteine, magnifies the imbalance of essential amino acids (Bhargava & O’neil 1975; Baker et al. 1981).

Thus, there is a growing interest in alternative methods for the treatment of feathers to improve the nutritional quality of the feather meal and to develop new and useful by-products from feathers. The nutritional value of the feather meal might be improved by microbial action, this results in a modification of the structure of keratin, altering the resistance to the enzymes of the digestive tract. The literature reports that isolates of Bacillus lichenformis (Williams et al. 1991) and Streptomyces pactum (Böckle et al. 1995) grown on feather media were able to modify the digestibility and profiles of the specific amino acids that were liberated. The bacterial cells incorporated into the fermented feathers may contribute to some amino acids, hence improving their balance. Also, feather as a fermentation substrate may be useful in order to obtain other microbial products (proteolytic enzymes, carotenoid pigments, etc.).

We conducted a study on an isolate from the soil of a poultry-processing plant in order to determine microbial growth, possible keratinolytic activity and optimum feather degradation conditions in submerged fermentation. To our knowledge, this is the first report describing the capacity of Kocuria rosea to degrade feathers.

2. ISOLATION, IDENTIFICATION AND ADAPTATION OF FEATHER-DEGRADING MICROORGANISMS

Isolating microorganisms from nature is the microbiologists first step in screening for natural microbial products. It is possible to isolate many different microorganisms by employing enrichment techniques on the appropriate culture medium. One successful approach for the discovery of new metabolites involves considering the characteristics of the desired product and process development and using ecological approaches for isolation and screening. Consideration of the ecological approaches to isolation can provide a screen with both a large number and a wide variety of microorganisms to examine for the product of interest. Even though microorganisms are highly adapted, specific microbial types are associated with different niches within a variety of ecosystems. Therefore, what is isolated from the defined ecosystem or habitat is a reflection of the isolation procedures and of the conditions found in nature.

2.1. ISOLATION AND DEGRADATION OF FEATHERS BY A MICROBIAL ISOLATE

Based on the capacity of some microorganisms to grow in a medium containing feather powder as the primary organic substrate for supplying carbon and energy a feather-degrading isolate was obtained from soil of a poultry processing plant (Figure 1). It was found that a culture of the feather-degrading isolate contained microorganisms exhibiting at least two distinct colony morphologies (red and white) when streaked onto nutrient agar plates. The white colony contained only rod-shaped bacteria, whereas the red colony was a coccus-shaped bacteria, which appeared singly and in chains. Although each type displayed clearing zones when streaked onto the potter-milled feather agar plates, the red colony produced the more pronounced clearing zones. The