1- INTRODUCTION

Colorants are considered to be essential in food-stuff industry manufacturing process. Food coloration improves food presentation and thus became an important goal in food industry. Food colorants may be natural or synthetic and often devoid of nutritional value. Patents on natural pigments are outnumbering the synthetic ones by five to one **(Francis, 1989)**. The production of synthetic coloring agents used as food additive is under increasing pressure due to a renewed interest in the use of natural products in food formulations and the strong interest in minimizing the use of chemical agents to produce food ingredients. Also, the number of permitted synthetic colorants has decreased because some have undesirable toxic effects including, mutagenicity, allergicity, and potential carcinogenicity.

So, there is worldwide interest in the process of pigment production from natural sources due to a serious safety problem with many artificial synthetic colorants, which have widely been used in foodstuff, cosmetic and pharmaceutical manufacturing processes **(Kim *et al*., 1995)**. It is well known that a variety of plants, animals and microorganisms produce pigments **(Cho *et al*., 2002)**. Although there are a number of natural pigments, only a few are available in sufficient quantities to be useful for industry because they are usually extracted from plants **(Lauro, 1991)**. Therefore, it is advantageous to produce natural pigments from microorganisms.

Filamentous fungi have important properties which play a significant role in the human lifestyle and in the environment, by

participating in the production of food and health products, and in recycling of organic compounds in the biosphere. Their biochemical potential and their adaptation to extreme life conditions in liquid media have been exploited to produce molecules such as antibiotics, enzymes, amino acids, organic acids and food colorants.

There are a number of microorganisms which have the ability to produce pigments in high yields. Amongst them, many species of *Monascus* have attracted special attention because they have the capability of producing different colored pigments showing high unique characteristics that make them of great interest not only as natural ingredients of food and medicines, but also as intermediates of novel dyestuffs for the fabrication of biodegradable polymers, textiles and cosmetics **(Hajjaj *et al.*, 2000)**. The red pigments produced in solid-state fermentation (SSF) by several *Monascus* spp., have been traditionally used in many Asian countries for coloring and securing a number of fermented foods. Furthermore, their therapeutic properties and their relatively high stability with respect to pH and temperature are interesting features, which favour their use as substitutes for synthetic colorants **(Cho *et al.*, 2002)**.

The traditional fermentation process involving SSF is labour-intensive, time-consuming and requires large cultivation areas, therefore the utilization of submerged fermentation (SmF) technique for the production of *Monascus* pigments has been studied to overcome the problems of space, scale-up and process control of SSF **(Lee and Chen, 1998)**. Pigment yields in SmF are highly

affected by the carbon and nitrogen sources, oxygen, temperature and the initial value of pH in the system and other factors.

The objective of this study is to investigate red pigment production by *Monascus purpureus* (local isolated strain) in SmF conditions. The following points were investigated:

1- Screening of the most potent local fungal isolates for their red pigment production.
2- Optimization of different growth parameters for red pigment production by the most potent producer fungus.
3- Enhancement of red pigment production by gamma radiation treatment as a mutagenic agent.
4- Continuous production of red pigment from potato processing wastewater (PPW) by immobilization techniques.
5- Toxicity and antimicrobial properties of the produced red pigment.