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Editorial Open Access

# Role of Microbial Enzymes in the Biodegradation of Rice Straw via Biotechnological Techniques

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## Editorial

As a main source of nourishment for over half the world's population, rice is by far one of the most important commercial food crops. Its annual yield worldwide is approximately 535 Mt. In Egypt, after the harvest of rice every autumn (October-November), Egyptian farmers generate about 30 Mt of agricultural wastes per year and start burning at least 4 t of hay in a very short time to prepare their land for the next season.

Environmentalists blame the burning of rice straw, for the pall of smoke known by "Black Cloud", a mass of polluted air, which spreads across Cairo and the Nile valley for several weeks and turns the capital's already noxious air into an even more toxic mix. Black cloud is comprised of a mix of volatile organic compounds, carcinogenic substances, sulfur oxides, nitrogen oxides and also invisible gases like carbon monoxide. It is responsible for about 42% of autumnal air pollution.

According to health workers, the black cloud has an adverse effect on people's health, causing respiratory problems. The number of bronchial asthma patients doubles at this time of the year. Therefore, the challenge for Egypt is to develop the cost-effective technologies to revive an economy and to convince farmers not to burn rice straw.

A suitable technology for the use of rice straw is an important contribution to reduce air pollution. Rice straw has a plenty of potential uses; the gathered rice straw is mainly used to make fertilizers. Egyptian scientists have been using rice straw in different projects to produce a variety of materials from pulp for paper production to active carbon for use in water filters or natural fiber plastic composites. The development of biotechnological methods based on enzymes production could provide a renewable resource of recycled rice straw for several industrial applications and as an animal feeding source.

High cost of the production is perhaps the major constraint in commercialization of new sources of enzymes. Therefore, using an inexpensive substrate (rice straw), high yielding microbial strains, mutagenesis, optimal fermentation conditions and efficient enzyme recovery procedures can reduce the cost and economize the process of production [1].

The development of biotechnological methods based on xylanases, cellulases and pectinases enzymes could provide a renewable resource of recycled bio-molecules for application in several industrial applications. Microbial xylanases and cellulases are a group of industrial enzymes that have been the focus for much attention due to their application in the pulp and paper (bio-bleaching), textile, poultry industry, baking, clarifying juices, forage digestion and agriculture waste degeneration. Other useful industrial applications which could be obtained by xylanases and cellulases are depending on their ability to convert lignocellulosic material to fuels and chemicals [2].

A variety of microorganisms, including bacteria, yeast and filamentous fungi have been reported to produce cellulases and xylanases, in which the most potent producers are *Aspergillus oryzae* [3], *Trichoderma* sp. [4], *Bacillus* sp. [5] and *Streptomyces* sp. [6].

The majority of the species utilized for enzymes production were isolated directly from the environment and being submitted to mutation-selection processes. Mutations are inheritable changes which occur in the genome as the result of a variety of different events and may involve nucleotide bases of the DNA molecule, sequences of bases or large regions of the fungal chromosome. The frequency of natural mutation of a specific gene is very low and is far too infrequent to satisfy industry's requirements for continual strain improvement. Therefore, to meet this need it is necessary to induce mutation using a mutagenic agent. This is usually achieved by using a physical agent such as X-rays or ultraviolet light (UV), or a chemical mutagen such as N-methyl-N-nitro-N-nitrosoguanidine (NTG), nitrous acid and ethyl-methane sulphonate (EMS). The main effect of mutagens is to induce a lesion or a modification of the base sequence of the DNA molecule [7].

Mutagenic agents have been applied to several fungal strains to improve cellulases production. For instance, the simultaneous treatment of *Fusarium oxysporum* with NTG, UV and NTG combined with Co60 γ-rays created a mutant that more exuberantly produced cellulases than wild type strain [8]. Recently, we used UV-irradiation followed by NTG to mutate the wild type cellulase producing fungal strain *Aspergillus oryzae* NRRL 3484 and created a mutant strain UNAC4 exhibiting higher cellulase activity with a yield of 4-folds exceeding that of the wild type [3].

In recent years, due to the excessively increasing cost of enzyme production, solid state fermentation (SSF) technique has emerged as an advantageous method for cellulase production over submerged fermentation. SSF is an economical process that occurs in the absence of free flowing water using natural polymers derived from agro-industrial residues with low energy requirement and less water output. Additionally, SSF technique is of special economic interest for countries with large amount of agro-industrial residues [9].

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