

Biological Tools to Deal with Pollution: Selected Advances and Novel Perspectives

Abdelaziz GHANEMI^{1,2}, Besma BOUBERTAKH³

¹ Key Laboratory of Animal Models and Human Disease Mechanisms, Kunming Institute of Zoology Chinese Academy of Sciences Yunnan Province, China

² University of Chinese Academy of Sciences, Beijing, China

³ State Key Laboratory of Natural Medicines, China Pharmaceutical University, China

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ABSTRACT

Pollution represents a problem common to economy and public health. Indeed, the public health, because of the divers' types of pollutions, is facing divers challenges for which urgent solutions are required. The biology provides approaches not only to deal with the pollution, but also to obtain economic benefits. Some living organisms have particular metabolisms that allow them to assimilate and metabolite the polluting agents and thus reduce the impact they have on both environment and public health. On the other hand, the metabolic properties of specific organisms make the polluting elements raw materials to synthesize other elements that benefit economy and that are non-toxic for the ecology and the biohealth. Yet, other options such as the regulations and laws are required to improve the efficiency of these approaches.

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Corresponding Author:

Abdelaziz GHANEMI,
Key Laboratory of Animal Models and Human Disease Mechanisms,
Kunming Institute of Zoology Chinese Academy of Sciences,
No.32 JiaochangDonglu, Kunming 650223, Yunnan Province, China.
Email: ghanemiabdelaziz@hotmail.com.

1. INTRODUCTION

As a consequence of development in many fields, the modern societies worldwide are facing a variety of pollution related problems that result mainly in both environment [1]-[5] and public health deteriorations [6]-[12]. Indeed, pollutions ,especially in big cities, due basically to the industrial activities, have negative effects on air quality [13],[14], soil [15],[16] water [17]-[20] and the divers existing life forms [21]-[23] that represent the biological entities of the ecosystems ,thus, vegetations, animals and humans are less likely to exist in a healthy state which can influence for example the crops of the agriculture and thus, the food security by influencing elements including the yields [24]-[26]. In addition the economic impacts of the pollution are also important and make reducing pollution crucial for the financial stability as well [27],[28]. All these parameters influence the quality of the life of citizens and the whole country development. Thus, solutions to deal with these phenomena are required as an urgent matter. However, these solutions should not stop or suspend the economic development of the country.

The best ways remains to make a balance between a sustainable technological development and a pollution control that would consider the sanitary aspects and the ecological issues; this would be possible through making efficient exploitations of the recent scientific and technological advanced tools within different facilities especially those with heavy impactson environment and human health. Herein, selected examples are presented to illustrate these concepts.

2. PRACTICAL SOLUTIONS

Regarding the industrial installations, and depending on the wastes they produce (CO₂, organic products, mineral chemicals, etc), we should consider making use of biological advances [29], such as including bacterial cultures [30],[31], fungi cultures [32] or algae cultures [33] into specific compartments within the installations or in the natural environment such as agricultural soils. The wastes would be passed via these compartments to be clarified and purified. The clarification and purification principle is based on the properties of these cultures (bacterial, fungal and algal) to consume or assimilate elements that are included within the wastes [34] (CO₂, organic products or mineral chemicals) and incorporate them within their metabolism and this would help to avoid spreading these wastes in the rivers and the air for example. In addition, these biological organisms not only use the wastes in their metabolisms, but may also use them to produce elements that can be used in some industries [29], including fuel, pharmaceutical active compounds, elements used in food industry, etc, and as example, we mention lipid production [35] and metals accumulation by those organisms. This can be named as biological recycling of polluting agents to reintegrate them either to the ecological system or to industrial processes.

On the other hand, nearby the exo-energetic industries (exothermic), which produce heat [36], we can install-plantations of plants or animals that are adapted to the hot climate such as deserts [37], which means we use the heat and the energy produced by certain installations to create an artificial environment that mimics zones like deserts and tropical areas, and thus, we could produce crops that need high temperatures and raise animals that live in the hot climate. More important, this approach could allow us to use the generated energy and heats instead of spreading it within the atmosphere and contribute in increasing the global temperature. The application of these aspects would be beneficial not only for agriculture, animal husbandry, but also might have an improving effect on tourism through creating touristic scenic spots such as botanical gardens and zoological parks; however, it is vital to consider parallel the application of other possible purification methods to ensure the safest environment conditions. These methods that would reduce the polluting elements such as CO₂, would also, since they are mainly based on the use of biological organisms, produce oxygen and reduce the heat released in the nature, which means that these methods would contribute in reducing the global warming [38]-[40].

Moreover, we can apply domestication methods, breeding and genetic modification techniques to improve these biological organisms' properties [41]-[43] through developing organisms with new traits that would be more likely to achieve the purposes we are seeking which means more efficient organisms with better properties.

Importantly, these proposed solutions have the advantages to provide economic outcome and financial benefits, which make them different from the classical methods such as filters [44],[45], which might be costly and with less benefits. Since these methods could be highly beneficial at several levels, they might, most probably, be successful and more likely to attract investments, particularly because they are economical and eco-friendly at the same time. Solving the problem of disposing industrial wastes is beneficially, not only by managing wastes and emissions, but also through considering them as raw materials for other sectors rather than just a problem to deal with. Indeed, these pollutants will become a resource to produce other elements that would be used, for instance in industry or agriculture.

Another option would be to put laboratory animals, microorganisms and plants nearby the industrial stations and installations, which are suspected to influence the bio-health and the ecological system, then it is suggested to study and investigate those living organisms transformations under this environmental and artificial circumstances during a period of time estimated via extrapolation from the existing data and based on the plant or animal type and ability to resist. This could lead to obtain more precise and more accurate data about the impact those stations and installations have on living organisms. The investigations should be complete and include medical, toxicological, pathological hydrological [46] and other relevant biological and environmental required studies[47-50], in addition of collecting geological, climatologic and chemical data in order to come out with thorough investigations, eventual linkage and fruitful conclusions.

3. IMPLICATIONS

More general concepts emerge from the extrapolation of these approaches. Indeed, for each type of pollution or industrial wastes we may deal with, we should consider the appropriate scientific and technological methodologies that could allow us to use these wastes to produce new compounds for further industrial use for example or create new artificial environments to both study the pollution impact and a small level within a selected sample and make use of these artificial environments to produce biological entities such as agricultural crops.

Undoubtedly, methods and standard for pollution evaluation should be improved and optimized [21],[47],[51]-[60] although currently some many methods exist such as the use of divers organisms cultures

as indicator of the pollution degree and the biological impact [61]-[63] some of them have limits and disadvantages.

Yet, the combination of knowledge from many fields and the common efforts of experts in different areas, supported by efficient legislations [64]-[66], political willing and a scientific education of the citizens [67],[68] will make as going ahead toward realizing such projects for the benefits of all in order to achieve the best results.

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BIOGRAPHY OF AUTHOR



Abdelaziz GHANEMI was born on October, 11th, 1986 in Algiers (Algeria). He finished his elementary and high school education in Constantine (Algeria). In 2004, he graduated from Houari Boumediène High School with the Secondary Education Baccalaureate Degree with honors (Good). In 2009, Abdelaziz GHANEMI graduated from the Medicine Faculty of Mentouri Constantine University (Algeria) with a Pharmacist Diploma (Valedictorian). From September 2009 to June 2010: Chinese language Class at China Pharmaceutical University (Nanjing city, Jiangsu Province, China). From September 2010 to June 2013: Master's degree (Msc) in Pharmacology at China Pharmaceutical University (China). In addition to Arabic (mother tongue), Mr.GHANEMI has English, French and Chinese language proficiency certificates. The author does research and has publications about both pharmacology and neuroscience-related fields.