

## Antibiotic and heavy metal resistance of bacterial isolates obtained from some lakes in northern Germany

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**ABSTRACT** The problem of antibiotic resistance in bacteria is discussed. Investigations involving bacteria, isolated from some densely populated, thinly populated and unpopulated places, are highlighted. The problem appears to be unavoidable even by restricting the use of antibiotics.

### Introduction

Antibiotics are powerful tools for controlling the pathogenic bacteria. However emergence of antibiotic resistance in bacteria continues to be a serious problem that blunts the advantage of using antibiotics as a chemotherapeutic agent. The euphoria following discovery of a number of therapeutically useful antibiotics during the 1940s and 1950s did not last long. Detection of penicillin-resistant bacteria was reported within four years of introduction of penicillin into the clinical practice. At present resistance to virtually all the clinically useful antibiotics has been evidenced. It is apprehended by some scientists that we might be pushed back to a situation resembling the pre-antibiotic era.

### The Antibiotic Paradox

According to the *Antibiotic Paradox* theory of Professor Stuart B.Levy (Tufts University School of Medicine, Boston, USA), use of antibiotics itself is contributing to the problem of microbial resistance to antibiotics<sup>1</sup>. Our natural environment is inhabited by a mixed population of antibiotic-sensitive and antibiotic-resistant bacteria. By indiscriminate and imprudent use of antibiotics (using antibiotics for trifling illness, mixing antibiotics with animal feed,

dumping unused antibiotic formulations here and there), we are annihilating the sensitive bacteria, which outnumber and suppress the resistant bacteria. By killing the friends, we are making it a cakewalk for the foes. Antibiotic-resistant organisms are selected out of the mixed population. They start growing unrestrained in absence of any challenge posed by the sensitive bacteria.

The foregoing discussion indicates that it might be possible to bypass the problem of antibiotic resistance simply by restricting the use of antibiotics. However, antibiotic resistant organisms are selected in the natural environments not only in presence of antibiotics but also in presence of some non-antibiotic substances including heavy metals (mercury, arsenic, lead, cadmium and some other metals). Genes conferring antibiotic resistance and genes conferring heavy metal resistance are most often found to be located on the same plasmid. That is why, if heavy metals are present in an environment as pollutant, many bacteria that survive in presence of them are found to be resistant not only to heavy metals but also to antibiotics. Thus antibiotic resistant organisms are selected to flourish even in absence of antibiotics. A vast body of information is available in the literature on co-occurrence of antibiotic and heavy metal

resistance in various types of natural isolates of bacteria.<sup>2</sup>

### Our Observations

The northern part of Germany is dotted with many lakes. These areas are one of the least populated places of Europe. So chance of human intervention leading to emergence of antibiotic resistance is expected to be negligible in these areas. During the CSIR-DAAD Exchange of Scientists Programme (Nov-Dec 2009) we tested some 66 bacterial isolates having different phylogenetic affiliations, for resistance to 11 antibiotics and 3 heavy metal salts at the Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB-Neuglobsow), Germany. These isolates were obtained from the nearby lakes. Besides widespread resistance to various antibiotics (including chloramphenicol, which is no longer used in the western countries for therapeutic purpose) and heavy metals, we also noticed co-occurrence of antibiotic and heavy metal resistance in various frequencies. One

isolate was resistant to 7 antibiotics and 3 heavy metals<sup>3</sup>.

### Conclusion

A recent survey involving 264 isolates from soil, sampled from different natural habitats in and around Hyderabad (Andhra Pradesh, India), revealed resistance to antibiotics that are being used for the last few decades as well as to antibiotics that have been recently introduced<sup>4</sup>. Resistance to a number of antibiotics was detected at the Centre for Cellular and Molecular Biology (CSIR), Hyderabad in bacteria, isolated from different types of Antarctic samples (soil, snow, cyanobacterial mat)<sup>5</sup>. These reports along with our observations reveal that antibiotic resistance in bacteria emerges in places, where antibiotic is likely to be present in the environment as well as in places where antibiotic is not likely to be present. Hence, it might be possible to delay the emergence of antibiotic resistance but it is definitely not possible to completely bypass the problem by restricting the use of antibiotics.

### Acknowledgement

The investigators thankfully acknowledge the financial assistance received from the Council of Scientific and Industrial Research (CSIR), New Delhi, India and Deutscher Akademischer Austausch Dienst (DAAD, German Academic Exchange Service), Bonn, Germany.

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