Linkage of heavy-metals and antibiotics resistance of bacterial strains isolated from the marine environment

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Introduction.

The resistance ability of some microbial groups against heavy metals and antibiotics has been detected frequently. Some studies show that the strains resistant to these agents can be isolated from different environments, such as gastrointestinal tract of man and domestic animals, aquatic environments, soils and clinical samples (3,4,5). The high frequencies of resistant strains may be caused by the selection process induced by heavy metal pollution of these environments and the widespread use of antibiotics in agriculture and medicine. Genetic transfer is considered to be another factor responsible for increasing the isolation frequencies of these strains. The purpose of this study is to determine the relationship between heavy metal and antibiotic resistance patterns of microorganisms (bacterial indicators and pathogens) isolated from the marine environment (water, shellfish and sediments).

Material and Methods.

Samples were collected in the marine area near the Guadalhorce river mouth and in beaches affected by sewage discharges in Málaga (Spain). The studied microorganisms belong to two groups: fecal pollution indicators (Coliforms and Fecal Streptococci), and pathogens (*Pseudomonas aeruginosa, Salmonella* spp, *Aeromonas hydrophila, Vibrio* spp, and *Staphylococcus* spp). The culture media employed for isolation of the microorganisms were: Endo agar, KF agar, Cetrimide agar, XLD agar, mA agar, TCBS agar and Mannitol salt agar for each microbial group, respectively. The study of heavy metal and antibiotic resistance patterns were determined by the agar dilution method and the disk diffusion method, respectively (6).

Results and Discussion.

The results obtained are summarized in Table 1, which shows the most frequent patterns of multir.esistance to metals and antibiotics of each microbial group. *Pseudomonas aeruginosa* presents the widest resistance profile; it should be noted that this is the general profile, and in addition some strains are also resistant to other agents, such as arsenate, streptomycin or sulfamides. These results are in agreement with those obtained by other authors (2,4,6).

In general, for Gram-negative microorganisms, except for *Salmonella* spp, the resistance patterns generally include the resistance to arsenate and amoxycillin, which seems to indicate a possible association of the resistance to both agents. Among Gram-positive microorganisms, the resistance pattern of *Staphylococcus* spp is more similar to the Gram-negative patterns, than to that of the Fecal Streptococci. Fecal Streptococci do not present a significant resistance to heavy metals. The linkage of resistance to mercury and amoxycillin is observed in *P. aeruginosa* and some Coliform strains, according to the results obtained by other authors (1,4).

TABLE 1. Heavy-metal and antibiotic multi resistance patterns of bacterial strains frequently isolated from the marine environment.

MICROORGANISMS	RESISTANCE PATTERNS	FREQUENCY (%)
P. aeruginosa (n=25)	Cd-Cr-Hg-AMX-CF-K-C-NA-SXT	28.0
	Cd-Cr-AMX-CF-K-C-NA-SXT	28.0
	Cd-Cr-Hg-AMX-CF-K-NA-SXT	12.0
Coliforms (n=56)	As-Hg-AMX	28.5
	As-AMX-CB-S-G	8.9
Salmonella spp (n=15)	–	–
A. hydrophila (n=32)	As-AMX-CF	40.6
Vibrio spp (n=22)	As-AMX-TE	36.3
Staphylococcus spp (n=12)	Cr-AMX	41.7
Fecal Streptococci (n=41)	Zn-S-K-L-G	31.7

As: Arsenate
Cd: Cadmium
Cr: Chromium
Hg: Mercury
Zn: Zinc

AMX: Amoxycillin
CB: Carbenicillin
CF: Cephalothin
C: Chloramphenicol
K: Kanamycin
L: Lyncomicin

NA: Nalidixic Acid
S: Streptomycin
G: Sulfamides
TE: Tetracicline
SXT: Trimethoprim-Sulfamethoxazole

References:

1 JOLY, B.; R. CLUZEL; P. HENRI & J. BARJOT, 1976. Ann. Microbiol. (Inst. Pasteur), 127B: 57-68.
2 JOLY, B.; J. ALAME; R. CLUZEL & D. PEPIN, 1979. Ann. Microbiol. (Inst. Pasteur), 130B: 341-347.
3 KELCH, W.J. & J.S. LEE, 1978. Appl. Environ.Microbiol., 36: 450-456.
4.MARQUES, A.M.; F. CONGREGADO & M.D. SIMON-PUJOL, 1979. J. Appl. Bacteriol., 47: 347-350.
5.NAKAHARA, H.; T. ISHIKAWA; Y. SARAI; I. KONDO; H. KOZUKUE & S. SILVER, 1977. Appl. Environ. Microbiol., 33: 975-976.
6.de VICENTE, A., 1986. Tesis Doctoral. Universidad de Málaga.

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