Chempedak isolates were found to be more susceptible to cadmium and copper at MIC range of 50-100 μg/ml. Interestingly, almost all isolates from Pantai Batu Hitam displayed high resistance to both chromium and nickel with MIC > 500 μg/ml and half of the isolates showed high resistance to both copper and cobalt with similar MIC. The resistance pattern associated with Teluk Chempedak and Pantai Batu Hitam were Cr > Ni >Co >Cd = Cu and Cr = Ni >Co >Cu >Cd respectively.

Table 3 depicts selected isolates from both location that exhibited both antibiotic and heavy metal resistance capabilities. Isolate TC 46 was resistant to 8 antibiotics and resistant to chromium, cadmium and cobalt with MIC range of 350-400 μg/ml while TC 48 was resistant to 7 antibiotics and resistant to chromium, cadmium and cobalt with MIC of 450 μg/ml. TC50, however, was resistant to 7 antibiotics and resistant to chromium and cadmium with MIC >500 μg/ml and MIC for cobalt of 450 μg/ml. Isolates BH 45 and BH 50 were resistant to 7 antibiotics and all were highly resistant to chromium, nickel, copper and cobalt with MIC > 450 μg/ml. Similar results was also obtained on isolate 6 that was resistant to 8 antibiotics. The genes encoding resistance to heavy metals can be located together with antibiotic resistance genes on either the same genetic structure or different genetic structures within the same bacterial strain Metal and antibiotic resistances are the most common features that bacteria gain due to the abuse of metals and/or antibiotic [12]. Recent studies have suggested that the presence of metal contamination in natural environments could play a role in the maintenance and proliferation of antibiotic resistance [13,14].

The 16S rRNA gene sequence analysis of isolate TC 50 revealed that it has the closest relationship to *Staphylococcus saprophyticus* ATC 15305 (100 %), while isolate BH 50 possess the closest relationship with 99 % similarity to *Brevundimonas vesicularis* IAM 12105. *S. saprophyticus* is a gram-positive coccus commonly found in urine specimen and a common cause of urinary tract infection. Reports on multiple antibiotic resistant *S. saprophyticus* were mostly related to clinical isolates from hospitals but none from the marine environment [15]. High number of tourists in Teluk Chempedak might implicate to high volume of waste water (excrete products, urine) discharged into the marine environment and which eventually led to its residing in the marine sediment. Additionally, there was no report on *S. saprophyticus* to possess both antibiotic and heavy metal resistant capabilities. Hence, this is the the first report of such incidence. Meanwhile, *B. vesicularis* can be isolated from the human end cervix, natural soil environments, bottled water and hospital environments [16]. This bacterium can cause arthritis, endocarditis, meningitis and primary bloodstream infection in immunocompromised as well as immunocompetent patient [17]. Similar to *S. saprophyticus,* reports on *B. vesicularis* were mostly on its multiple antibiotic resistance ability but none on the heavy metal resistant ability. Hence, this is the the first report of such incidence for both *S. saprophyticus* and *B. vesicularis.* Results obtained in this study indicated the possibility of marine environments of Teluk Chempedak and Pantai Batu Hitam were of poor microbiological quality which has led to bacterial isolates to gain resistance against several antibiotic agents and together with high numbers of heavy metal resistant bacteria could be the result of agrochemical and industrial pollution.

Table 1: Heavy metal tolerance in bacteria from marine sediment of Teluk Chempedak

Heavy	MIC (μg/ml) with number of tolerant isolates						
Metal	< 50	50-100	110-200	210-300	310-400	410-500	>500
Cd		45	5				
Co		11	29		5	5	
Cr				14	15	13	8
Cu		45	5				
Ni	10		17	16	2	3	2

Table 2: Heavy metal tolerance in bacteria from marine sediment of Pantai Batu Hitam

Heavy	MIC (μg/ml) with number of tolerant isolates						
Metal	< 50	50-100	110-200	210-300	310-400	410-500	>500
Cd		7	32				
Co		2	2	1	9	7	18
Cr		1					38
Cu		18		6			15
Ni		1					38

Table 3: Selected antibiotic and heavy metals resistance isolates from Teluk Chempedak (TC) and Pantai Batu Hitam (BH)

Isolates	Antibiotic	Heavy Metal
TC 46	Vancomycin, Ampicillin, Tetracycline, Chloramphenicol, Penicillin G, Streptomycin, Gentamycin, Rifampicin	Chromium, Cadmium, Cobalt
TC 48	Vancomycin, Ampicillin, Tetracycline, Chloramphenicol, Gentamycin, Rifampicin, Penicillin G	Chromium, Cadmium, Cobalt
TC 50	Vancomycin, Ampicillin, Tetracycline, Chloramphenicol, Gentamycin, Rifampicin, Penicillin G	Chromium, Cadmium, Cobalt
BH 6	Vancomycin, Ampicillin, Tetracycline, Chloramphenicol, Penicillin G, Streptomycin, Gentamycin, Rifampicin	Chromium, Copper, Cobalt, Nickel
BH 45	Vancomycin, Tetracycline, Chloramphenicol, Erythromycin, Streptomycin, Gentamycin, Rifampicin	Chromium, Copper, Cobalt, Nickel
BH 50	Vancomycin, Tetracycline, Chloramphenicol, Erythromycin, Streptomycin, Gentamycin, Rifampicin	Chromium, Copper, Cobalt, Nickel

4. CONCLUSION

In conclusion, the occurrence of antibiotic and heavy metal resistant bacteria in Pahang coastal water indicated the impact of human activities on the marine environment which constituting a risk to the public health and pose a threat to the marine ecosystem. In addition, marine sediment in both locations probably represents a reservoir of multiresistant genetic elements which bacteria can attain through horizontal gene transfer.

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