

## REFERENCES

- Acar, J.F., and Goldstein, J.W.** (1982). Genetic aspects and epidemiologic implications of resistance to trimethoprim. *Rev. Infect. Dis.* **4**: 270-275.
- Agarwal, K.C., Panhotra, B.R., Mahanta, J., Arya, V.K., and Grag, R.K.** (1981). Typhoid fever due to chloramphenicol resistant *Salmonella typhi* associated with R plasmid. *Indian J. Med. Res.* **73**: 484-488.
- Akhtar, M.A., Karamat, K.A., Malik, A.Z., Hasmi, A., Khan, Q.M., and Rasheed, P.** (1989). Efficacy of ofloxacin in typhoid fever, particularly in drug resistant cases. *Rev. Infect. Dis.* **2 (Suppl. 5)**: s1193.
- Anand, A.C., Kataria, V.K., Singh, W., and Chatterjee, S.K.** (1990). Epidemic multi-resistant enteric fever in eastern India. *Lancet.* **i**: 352.
- Anand, N., and Davies, B.D.** (1960). Effect of streptomycin on *Escherichia coli*. *Nature.* **185**: 23-24.
- Anand, N., and Davies, B.D.** (1960). Uptake of streptomycin by *Escherichia coli*. *Nature.* **185**: 24-25.
- Anderson, E.S.** (1975). The problem and implications of chloramphenicol resistance in the typhoid bacillus. *J. Hyg.* **74**: 289-299.
- Anderson, E.S., and Smith, H.R.** (1972). Chloramphenicol resistance in the typhoid bacillus. *Brit. Med. J.* **3**: 329-331.
- Anderson, W.F., Gorini, L., and Breckenridge, L.** (1970). Role of ribosomes in streptomycin-activated suppression. *Proc. Natl. Acad. Sci. USA.* **54**: 1076-1083.

**Ansary, A., Ismail, S., and Cheong, Y.M.** (1995). Occurrence and genetic characterization of chloramphenicol resistant *Salmonella typhi* isolated in Malaysia. Malaysian J. Science **16A**: 33-38.

**Arnad, N., Davis, B.D., and Armitage, A.K.** (1960). Damage by streptomycine to the cell membrane of *Escherichia coli*. Nature. **185**: 23.

**Asperilla, M.O., Smego, R.A. Jr., and Scott, L.K.** (1990). Quinolone antibiotics in the treatment of *Salmonella* infections. Rev. Infect. Dis. **12**: 873-889.

**Bagdasarian, M., Bagdasarian, M.M., Lurz, R., Nordheim, A., Frey, A., and Timmis, K.N.** (1982): Molecular and functional analysis of the broad host range plasmid RSF1010 and construction of vectors for gene cloning in Gram-negative bacteria. In Mitsuhashi, S. (Ed.), Bacterial Drug Resistance. Japan Scientific Society Press, Tokyo, pp. 183-197.

**Bagdasarian, M., Lurz, R., Rückert, B., Franklin, F.C.H., Bagdasarian, M.M., Frey, J., and Timmis, K.N.** (1981): Specific purpose plasmid cloning vectors, II. Broad-host-range, high-copy-number, RSF1010-derived vectors, and host vector system for gene cloning in *Pseudomonas*. Gene. **16**: 237-247.

**Bagdasarian, M.M., Scholz, P., Frey, J. and Bagdasarian, M.** (1987): Regulation of the *rep operon* expression in the broad host range plasmid RSF1010. In Novick, R., and Levy, S. (Eds.), Evolution and Environmental Spread of Antibiotic Resistance Genes. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, pp. 209-223.

**Bennett, P.M., and Hawkey, P.M.** (1991). The future contribution of transposition to antimicrobial resistance. J. Hosp. Infect. **18 (Suppl. A)**: 211-221.

**Bennett, P.M., Grinsted, J., and Richmond, M.H.** (1977). Transposition of Tn4 does not generate deletions. Mol. Gen. Genet. **154**: 205-211.

**Bennett, P.M., Grinsted, J., Choi, C.L., and Richmond, M.H.** (1978). Characterization of Tn501, a transposon determining resistance to mercuric ions. Mol. Gen. Genet. **159**: 101-106.

**Benveniste, R., and Davies, J.** (1973). Aminoglycoside antibiotic-inactivating enzymes in actinomycetes similar to those present in clinical isolates of antibiotic-resistant bacteria. Proc. Natl. Acad. Sci., USA. **70**: 2276-2280.

**Birnboim, H. C., and Doly, J.** (1979). A rapid alkaline extraction procedure for screening recombinant plasmid DNA. Nucleic Acids Res. **7**: 1513-1523.

**Birnboim, H.C.** (1983). A rapid alkaline extraction method for the isolation of plasmid DNA. Methods Enzymol. **100**: 243-255.

**Bissonnette, L., and Roy, P.H.** (1992). Characterization of InO of *Pseudomonas aeruginosa* plasmid pVSI, an ancestor of integrons of multiresistance plasmids and transposons of Gram-negative bacteria. J. Bacteriol. **174**: 1248-1257.

**Brown, J.D., Mo, D.H., and Rhoades, E.R.** (1975). Chloramphenicol-resistant *Salmonella typhi* in Saigon. JAMA. **231**: 162-166.

**Brown, N.L., Misra, T.K., Winnie, J.N., Schmidt, A., Seiff, M., and Siver, S.** (1986). The nucleotide sequence of the mercuric resistance operons of plasmid R100 and transposon Tn501: further evidence for *mer* genes which enhance the activity of the mercuric detoxification system. Mol. Gen. Genet. **202**: 143-151.

**Bryan, L.E., and Kwan, S.** (1983). Roles of ribosomal binding, membrane potential, and electron transport in bacterial uptake of streptomycin and gentamicin. Antimicrob. Agents Chemother. **23**: 835.

**Bukhari, A.I., Shapiro, J.A., Adya, S.L.** (eds). (1974). DNA: insertion elements, plasmids, and episomes. Cold Spring Harbor, N.Y. Cold Spring Harbor Laboratory.

**Butler, T., Nguyen, N.L., Arnold, K., Dickman, M.D., Duong, M.C., and Mach, M.M.** (1997). Therapy of antimicrobial-resistance typhoid fever. *Antimicrob. Agents. Chemother.* **II**: 645-650.

**Calos, M.P., and Miller, J.H.** (1980). Transposable elements. *Cell*. **20**: 579-595.

**Calquhoun, J., and Weetch, R.S.** (1950). Resistance to chloramphenicol developing during treatment of typhoid fever. *Lancet ii*: 621-623.

**Campbell, A., Berg, D.E., Lederberg, E.M., Starlinger, P., Botstein, D., Novick, R.P., and Szybalski, W.** (1979). Nomenclature of transposable elements in prokaryotes. *Plasmid*. **2**: 466-473.

**Carlos, M.P., and Miller, J.H.** (1980). Transposable elements. *Cell* **20**: 579-595.

**Cheong, Y.M.** 1992). Phage types of *Salmonella typhi* isolated in Malaysia over the last 10-year period 1980-1989. In Typhoid Fever: Strategies for the 90's. Selected Papers from the First Asia-Pacific Symposium on Typhoid Fever (Eds. Pang, T., Koh, C.L., and Puthucheary, S.D.), pp. 17-22. World Scientific Publishing Co. Pte. Ltd., Singapore.

**Chiou, C.S., and Jones, A.L.** (1993). Nucleotide sequence analysis of a transposon (Tn5393) carrying streptomycin resistance genes in *Erwinia amylovora* and other Gram-negative bacteria. *J. Bacteriol.* **175**: 732-740.

**Chong, S.S.** (1992). Conjugative R plasmids from Multiple Antibiotic Resistant Salmonella typhi Strains. B. Sc. (Hons.) thesis, session 1991/1992, Department of Genetics and Cellular Biology, University of Malaya.

**Chun, D., Seol, S.Y., Cho, D.T., and Tak, R.** (1977). Drug resistance and R plasmids in *Salmonella typhi* isolated in Korea. *Antimicrob. Agents Chemother.* **11**: 209-213.

**Cohen, S.N.** (1976). Transposable genetic elements and plasmid evolution. *Nature*. **263**: 731-738.

**Cohen, S.N., and Kopecko, D.J.** (1976). Structural evolution of bacterial plasmids: role of translocating genetic elements and DNA sequence insertions. *Fed. Proc.* **35**: 2031-2036.

**Collis, C., and Hall, R.** (1992). Site-specific deletion and rearrangement of integron insert genes catalyzed by the integron DNA integrase. *J. Bacteriol.* **174**: 1574-1585.

**Collis, C.M., and Hall, R.M.** (1992). Gene cassettes from the insert region of integrons are excised as covalently closed circles. *Mol. Microbiol.* **6**: 2875-2885.

**Collis, C.M., and Hall, R.M.** (1992). Site-specific deletion and rearrangement of integron insert genes catalyzed by the integron DNA integrase. *J. Bacteriol.* **174**: 1574-1585.

**Collis, C.M., Grammaticopoulos, G., Britton, J., Stokes, H.W., and Hall, R.M.** (1993). Site-specific insertion of gene cassettes into integrons. *Mol. Microbiol.* **9**: 41-52.

**Cox, E.C., White, J.R., and Flaks, J.G.** (1964). Streptomycin action and the ribosome. *Proc. Natl. Acad. Sci. USA.* **51**: 703-709.

**Daikos, G.L., Jackson, G.G., Lolans, V.T., and Livermore, D.M.** (1990). Adaptive resistance to aminoglycoside antibiotics from first-exposure down-regulation. *J. Infect. Dis.* **162**: 414.

**Datta, N., and Hughes, V.M.** (1983). Plasmids of the same Inc groups in enterobacteria before and after the medical use of antibiotics. *Nature*. **306**: 616-617.

**Datta, N., and Richards, H.** (1981). *Salmonella typhi* *in vivo* acquires resistance to both chloramphenicol and co-trimoxazole. *Lancet I*: 1181-1183.

**Datta, N., Hughes, V.M., Nugent, M.E., and Richards, H.** (1979). Plasmids and transposons and their stability and mutability in bacteria isolated during an outbreak of hospital infection. *Plasmid*. **2**: 182-196.

**Davies, J.** (1994). Inactivation of antibiotics and the dissemination of resistance genes. *Science* **264**: 375-382.

**De Graaf, J., Crosa, J.H., Heffron, F., and Falkow, S.** (1978). Replication of the non-conjugative plasmid RSF1010 in *Escherichia coli* K-12. *J. Bacteriol.* **134**: 1117-1122.

**de la Cruz, F., and Grinsted, J.** (1982). Genetic and molecular characterization of Tn21, a multiple resistance transposon from R100-1. *J. Bacteriol.* **151**: 222-228.

**Derbyshire, K.M., and Willets, N.** (1987). Mobilization of the non-conjugative plasmid RSF1010: a genetic analysis of its origin of transfer. *Mol. Gen. Genet.* **206**: 154-160.

**Derbyshire, K.M., Hatfull, G., and Willets, N.P.** (1987). Mobilization of the non-conjugative plasmid RSF1010: a genetic and DNA sequence analysis of the mobilization region. *Mol. Gen. Genet.* **206**: 161-168.

**Dickie, P., Bryan, L.E., and Pickard, M.A.** (1978). Effect of enzymatic adenylation on dihydrostreptomycin accumulation in *Escherichia coli* carrying R-factor: Model explaining aminoglycoside resistance by inactivating mechanisms. *Antimicrob. Agents Chemother.* **14**: 569.

**Dubin, D.T., Hancock, R., and Davies, B.D.** (1963). The sequence of some effects of streptomycin in *Escherichia coli*. *Biochim. Biophys. Acta*. **74**: 476-489.

**Edelman, R., and Levine, M.M.** (1986). Summary of an international workshop on typhoid fever. *Rev. Infect. Dis.* **8** (3): 329-349.

**Falkow, S.** (1975). *Infectious multiple drug resistance*. London: Pion. Ltd.

**Finch, M.J., Franco, A., Gotuzzo, E., Carillo, V., Benavente, L., Wasserman, S.S., Levine, M.M., and Morris, Jr. J.G.** (1992). Plasmids in *Salmonella typhi* in Lima, Peru, 1987-1988: epidemiology abs lack of association with severity of illness or clinical complications. *J. Trop. Med. Hyg.* **47**: 390-396.

**Fling, M.E., and Richards, C.** (1983). Nucleotide sequence of the trimethoprim resistant dihydrofolate reductase gene harboured by Tn7. *Nucleic Acids Res.* **11**: 5147-5148.

**Fling, M.E., Kopf, J., and Richards, C.** (1985). Nucleotide sequence of the transposon Tn7 gene encoding an aminoglycoside-modifying enzyme, 3"(9)-O-nucleotidyltransferase. *Nucleic Acids Res.* **13**: 7095-7106.

**Fling, M.E., Kopf, J., and Richards, C.** (1988). Characterization of plasmid pAZI and the type III dihydrofolate reductase gene. *Plasmid* **19**: 30-38.

**Francia, M.V., and Garcia Lobo, J.M.** (1996). Gene integration in the *Escherichia coli* chromosome mediated by Tn21 integrase (Int21). *J. Bact.* **178 (1)**: 894-898.

**Frey, J., and Bagdasarian, M.** (1989). The molecular biology of IncQ plasmids. In Prosmiscuous plasmids of Gram-negative bacteria. Edited by C.M. Thomas. Academic Press Inc., San Diego, Calif. pp. 95-124.

**Frey, J., Bagdasarian, M.M., and Bagdasarian, M.** (1992). Replication and copy number control of the broad-host-range plasmid RSF1010. *Gene* **113 (1)**: 101-106.

**Galas, D.J., and Branscomb, E.W.** (1976). Ribosome slowed by mutation to streptomycin resistance. *Nature* **262**: 617-619.

**Garcia-Riestra, C., Perlin, M.H., and Lerner, S.A.** (1985). Lack of accumulation of exogenous adenylyl dihydrostreptomycin by whole cells or spheroplasts of *Escherichia coli*. *Antimicrob. Agents Chemother.* **27**: 114.

**Garoff, H, and Ansorge, W.** (1981): Improvement of DNA sequencing gels. *Anal. Biochem.* **115**: 450-457.

**Gaynes, R.P., Simpson, D., and Reeves, S.** (1984). Colonization and infection of neonates with multiply resistant *Escherichia coli*. *Infect. Control.* **5**: 519.

**Goldstein, F.W., Chumpitaz, J.C., Guevara, J.M., Papadopoulou, B., Acar, J.F., and Vieu, J.F.** (1986). Plasmid-mediated resistance to multiple antibiotics in *Salmonella typhi*. *J. Infect. Dis.* **153**: 261-265.

**Gottlieb, D., and Shaw, P.D.(eds)** (1967). *Antibiotics* (Vol II): Biosynthesis. Springer- Verlag, New York.

**Grindley, N.D.F., and Reed, R.R.** (1985). Transpositional recombination in prokaryotes. *Ann. Rev. Biochem.* **54**: 863-896.

**Grinsted, J., Bennette, P.M., and Richmond, M.H.** (1977). A restriction enzyme map of R-plasmid RPI. *Plasmid* **1**: 34-37.

**Grinsted, J., de la Cruz, F., and Schmitt, R.** (1990). The Tn21 subgroup of bacterial transposable elements. *Plasmid* **24I**: 163-189.

**Guerry, P., Van Embden, J., and Falkow, S.** (1974): Molecular nature of two non-conjugative plasmids carrying drug resistance genes. *J. Bacteriol.* **117**: 619-630.

**Gupta, A.K., and Rao, K.M.** (1979). Simultaneous detection of *Salmonella typhi* antigen and antibody in serum by counter-immunoelectrophoresis for an early and rapid diagnosis of typhoid fever. *J. Immunol. Methods*. **30**: 349-353.

**Gupta, B.L., Bhujwala, R.A., and Shrinwas.** (1990). Multiresistant *Salmonella typhi* in India. *Lancet*. **336**: 252.

**Hall, R.M., and Collis, C.M.** (1994). Mobile gene cassettes and integrons: capture and spread of genes by site-specific recombination. Microreview.

**Hall, R.M., and Stokes, H.W.** (1990). The structure of a partial duplication in the integron of plasmid pDGO100. *Plasmid* **23**: 76-79.

**Hall, R.M., and Vockler, C.** (1987). The region of the IncN plasmid R46 coding for resistance to  $\beta$ -lactam antibiotics, streptomycin/spectinomycin and sulfonamides is closely related to antibiotic resistance segments found in IncW plasmids and in Tn21-like transposons. *Nucleic Acids Res.* **15**: 7491-7501.

**Hall, R.M., Brookes, D.E., and Stokes, H.W.** (1991) Site-specific insertion of genes into integrons: role of the 59-base element and determination of the recombination cross-over point. *Mol. Microbiol.* **5**: 1941-1959.

**Hanahan, D.** (1983). Studies on transformation of *Escherichia coli* with plasmids. *J. Mol. Biol.* **166**: 557-580.

**Haring, V., Scholz, P., Scherzinger, E., Frey, J., Hatfull, G., Willets, N.W., and Bagdasarian, M.** (1985): Protein RepC is involved in copy number control of the broad host range plasmid RSF1010. *Proc. Natl. Acad. Sci. USA.* **82**: 6090-6094.

**Hartl, D.L., Lozovskaya, E.R., Nurminsky, D.L., and Lohe, A.R.** (1997). What restricts the activity of mariner-like transposable elements? *Trends Genet.* **13**: 197-201.

**Heffron, F.** (1983). Tn3 and its relative. In: Shapiro, J.A. (ed.) *Mobile genetic elements*. Academic press, N.Y. pp: 223-260.

**Hirsch, H. J., Starlinger, P., Brachet, P.** (1972). Two kinds of insertions in bacterial genes. *Mol. Gen. Genet.* **119**: 191-206

**Hoffman, S.L.** (1984). Typhoid Fever in Hunter's Tropical Medicine (6<sup>th</sup> Ed.). Strickland, G.T. (ed). WB Saunders Co, Philadelphia.

**Hornick, R.B.** (1994). *Salmonella typhi* in Infectious diseases: A treatise of infectious processes (5<sup>th</sup> Ed). Hoeprich, P.D., Jordan, M.C., and Ronald, A.R. (eds). pp.

**Hornick, R.B., and Greisman, S.** (). On the pathogenesis of typhoid fever. *Arch. Intern. Med.* **138**: 357.

**Hughes, V.M., and Datta, N.** (1983). Conjugative plasmids in bacteria of the "pre-antibiotic" era. *Nature* **302**: 725-726.

**Hummel, H., Piepersberg, W., and Böck, A.** (1980). 30S subunit mutations relieving restriction of ribosomal misreading caused by L6 mutations. *Mol. Gen. Genet.* **179**: 147.

**Hunter, J.E.B., Shelley, J.C., Walton, J.R., Hart, C.A., and Bennett, M.** (1992). Apramycin resistance plasmids in *Escherichia coli*: possible transfer to *Salmonella typhimurium* in calves. *Epid. Infect.* **108**: 271-278.

**Hyde, D.R., and Tu, C.-P.D.** (1985). *TnpM*: a novel regulatory gene that enhances Tn21 transposition and suppresses cointegrate resolution. *Cell*. **42**: 629-638.

**Iida, S., Meyer, J., and Arber, W.** (1983). Prokaryotic IS elements. In: Mobile genetic elements. (Shapiro, J.A., ed.). Academic Press, New York. pp. 159-221.

**Ivanoff, B.** (1994). Typhoid fever: Global situation and WHO recommendations. Sarasombath, S., and Senawong, S. (eds). Southeast Asian Journal of Tropical Medicine and public health. 2<sup>nd</sup> Asia-Pacific Symposium on typhoid fever and other Salmonellosis. **26** (Suppl. 2):

**Jegathesan, M., and Khor, S.Y.** (1980). First isolates of chloramphenicol resistant *S. typhi* in Malaysia. *Med. J. Malaysia* **34**: 395-398.

**Jesuadson, M.V., and John, T.J.** (1990). Multiresistant *Salmonella typhi* in India. *Lancet* **336**: 256.

**Jones, D.S.C., and Schofield, J.P.** (1990). A rapid method for isolating high quality plasmid DNA suitable for DNA sequencing. *Nucleic Acids Res.* **18**: 7463-7464.

**Kadambeswaran, B.** (1993). Plasmid-and Transposon-Mediated Resistance in Two Multiple Antibiotic Resistant *Salmonella typhi* Isolates. B.Sc. (Hons.) thesis, session 1992/93, Department of Genetics and Cellular Biology, University of Malaya.

**Kado, C.I., and Liu, S.T.** (1981). Rapid procedure for detection and isolation of large and small plasmids. *J. Bacteriol.* **45**: 1365-1373.

**Karmaker, S., Biswas, D., Shaikh, N.M., Chatterjee, S.K., Kataria, S.K., V.K., and Kumar, R.** (1991). Role of a large plasmid of *Salmonella typhi* encoding multiple drug resistance. *J. Med. Microb.* **34**: 149-151.

**Kleckner, N.** (1981). Transposable elements in prokaryotes. *Ann. Rev. Genet.* **15**: 341-404.

**Koh, C.L., Lim, M.E., and Wong, Y.H.** (1983). Plasmid-mediated transferable chloramphenicol and tetracycline resistance in *Salmonella typhi* (Vi Phage Type 25) isolated in Peninsular Malaysia. *Med. J. Malaysia* **38**: 320-324.

**Kopecko, D.J., Brevet, J., and Cohen, S.N.** (1976). Involvement of multiple translocating DNA sequences and recombinational hotspots in the structural evolution of bacterial plasmids. *J. Mol. Biol.* **108**: 333-360.

**Kratz, J., Schmidt, F., and Wiedemann, B.** (1983). Characterization of Tn2411 and Tn2410, two transposons derived from R-plasmid R1767 and related to Tn2603 and Tn21. *J. Bacteriol.* **155**: 1333-1342.

**Lafond, M., Couture,F., Vézina, G., and Lévesque, R.C.** (1989). Evolutionary perspectives on multiresistance  $\beta$ -lactamase transposons. *J. Bacteriol.* **171**: 6423-6429.

**Lee K-Y, Hopkins, J.D., and Syvanen, M.** (1990). Direct involvement of IS26 in an antibiotic resistance operon. *J. Bacteriol.* **172**: 3229-3236.

**Lévesque, C., Brassard, S., Lapointe, J., and Roy, P.H.** (1994). Diversity and relative strength of tandem promoters for the antibiotic resistance genes of several integrons. *Gene* **142**: 49-54.

**Levy, S.** (1992). Active efflux mechanisms for antimicrobial resistance. *Antimicrob. Agents Chemother.* **36**: 695-703.

**Lim, Y.H.** (1992). Epidemiology, clinical features and treatment of typhoid fever in Malaysia. In Typhoid Fever: Strategies for the 90's. Selected Papers from the First Asia-Pacific Symposium on Typhoid Fever (Eds. Pang, T., Koh, C.L., and Puthucheary, S.D.), pp. 84-93. World Scientific Publishing Co. Pte. Ltd., Singapore.

**Ling, J., and Chau, P.Y.** (1984). Plasmids mediating resistance to chloramphenicol, trimethoprim, and ampicillin in *Salmonella typhi* strains isolated in the Southeast Asian Region. *J. Infect. Dis.* **149**: 652.

**Lupski, J.R.** (1987). Molecular mechanisms for transposition of drug-resistance genes and other movable genetic elements. *Rev. Inf. Dis.* **9 (2)**: 357-368.

**Lye, F.S.** (1997). Subcloning of the Trimethoprim Resistance Gene of a Multiple Antibiotic Resistance Transposon from Salmonella typhi. B.Sc. (Hons.) thesis, session 1996/1997, Department of Genetics and Cellular Biology, University of Malaya.

**Maher, D., and Taylor, D.E.** (1993). Host range and transfer efficiency of incompatibility group HI plasmids. *Can. J. Microbiol.* **39**:581-586.

**Martinez, E., and de la Cruz, F.** (1988). Transposon Tn21 encodes a RecA-independent site-specific integration system. *Mol. Gen. Genet.* **211**: 320-325.

**Martinez, E., and de la Cruz, F.** (1990). Genetic elements involved in Tn21 site-specific integration, a novel mechanism for the dissemination of antibiotic resistance genes. *EMBO J.* **9**: 1275-1281.

**Mercier, J., Lachapelle, J., Couture, F., Lafond, M., Vézina, G., Boissinot, M., and Lévesque, R.C.** (1990). Structural and functional characterization of *tnpI*, a recombinase locus in Tn21 and related β-lactamase transposons. *J. Bacteriol.* **172**: 3745-3757.

**Messing, J.** (1983). New M13 vectors for cloning. *Methods Enzymol.* **101 part C**: 20-78.

**Meyer, J.F., Nies, B.A., and Wiedemann, B.** (1983). Amikacin resistance mediated by multiresistance transposon Tn2424. *J. Bacteriology* **155**: 755-760.

**Miklos, D.A. and Freyer, G.A.** (1990). DNA Science. A First Course in Recombinant DNA Technology. Carolina Biological Supply Company and Cold Spring Harbor Laboratory Press.

**Mirza, S.H., and Hart, C.A.** (1993). Plasmid encoded multi-drug resistance in *Salmonella typhi* from Pakistan. *Annals. Trop. Med. Parasitol.* **87**: 373-377.

**Mitsuhashi, S., Hashimoto, H., Iyobe, S., and Ionue, M.** (1977). Formation of conjugative drug resistance (R) plasmids. In DNA Insertion Elements, Plasmids and Episomes (Eds. Bukhari, A.I., Shapiro, J.A., and Adhya, S.L.), pp.139-146. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.

**Modollel, J., and Davis, B.D.** (1968). Rapid inhibition of polypeptide chain extension by streptomycin. *Proc. Natl. Acad. Sci. USA.* **61**: 1279-1286.

**Modollel, J., and Davis, B.D.** (1969). Mechanism of inhibition of ribosomes by streptomycin. *Nature* **224**: 345.

**Modollel,J., and Davis, B.D.** (1970). Breakdown by streptomycin of initiation complexes formed on ribosomes of *Escherichia coli*. Proc. Natl. Acad. Sci. USA. **67**: 1148-1155.

**Mollet, B., S.Iida, Shepherd, J., and Arber, W.** (1983). Nucleotide sequence of IS26, a new prokaryotic mobile genetic element. Nuc. Acids Res. **18**:6319-6330.

**Murray, B.E., Levine, M.M., Cordano, A.M., D'ottone, K., Jayanetra, P., Kopecko, D., Pan-Urae, R., and Prenzel, L.** (1985). Survey of plasmids in *Salmonella typhi* from Chile and Thailand. J. Infect. Dis. **151**: 551-555.

**Narayanan, K.** (1995). Plasmid- and Transposon-Mediated Multiple Antibiotic Resistances in *Salmonella typhi*. B. Sc. (Hons.) thesis, session 1994/95, Department of Genetics and Cellular Biology, University of Malaya.

Nature. **222**: 333.

**Nies, B.A., Meyer, J.F., and Wiedemann, B.** (1986). Role of transposition and homologous recombination in the rearrangement of plasmid DNA. J. Antimicrob. Chemother. **18 (Suppl C)**: 35-41.

**Nisen, P.D., Kopecko, D.J., Chou, J., and Cohen, S.N.** (1977). Site-specific DNA deletion occurring adjacent to the termini of a transposable ampicillin resistance elements (Tn3). J. Mol. Biol. **117**: 975-998.

**Njoku-Obi, A.N., and Njoku-Obi, J.C.** (1965). Resistance of *Salmonella typhi* to chloramphenicol. J. Bacteriol. **90**: 552-553

**Nordheim, A., Hashimoto-Gotoh, T., and Timmis, K.N.** (1980). Location of two relaxation nick sites in R6K and single sites in pSC101 and RSF1010 close to origins of vegetative replication: implication for conjugal transfer of plasmid deoxyribonucleic acid. J. Bacteriol. **144**: 923-932.

- Olarte, J., and Galindo, E.** (1973). *Salmonella typhi* resistant to chloramphenicol, ampicillin, and other antimicrobial agents: strains isolated during extensive typhoid fever epidemic in Mexico. *Antimicrob. Agents Chemother.* **4**: 597-601.
- Ouellette, M., and Roy, P.H.** (1987). Homology of ORFs from Tn2603 and from R46 to site-specified recombinases. *Nucleic Acids Res.* **15**: 10055.
- Ouellette, M., Bissonnette, L., and Roy, P.H.** (1987). Precise insertion of antibiotic resistance determinants into Tn21-like transposons: nucleotide sequence of the OXA-1  $\beta$ -lactamase gene. *Proc. Natl. Acad. Sci. USA.* **84**: 7378-7382.
- Ozaki, M., Mizushima, S., and Nomura, M.** (1969). Identification and functional characterization of the protein controlled by the streptomycin-resistant locus in *Escherichia coli*.
- Pang, T., Calva, E., Punjabi, N., and Rowley, D.** (1992). Report from an international symposium on typhoid fever. *Asian Pac. J. Aller. Immunol.* **10**: 81-83.
- Pang, T., Koh, C.L., and Puthucheary, S.D.** (eds) (1992). *Typhoid fever: Strategies for the 90's*. World Scientific Publishing, Singapore: pp. 258.
- Paniker, C.K.J., and Vimala, K.N.** (1972). Transferable chloramphenicol resistance in *Salmonella typhi*. *Nature* **239**: 109-110.
- Perbal, B.V.** (1988). *A practical guide to molecular cloning* (ed). John Wiley and Sons, Inc., New York.
- Perlin, M.H., and Lerner, S.A.** (1981). Localization of an amikacin 3'-phosphotransferase in *Escherichia coli*. *J.Bacteriol.* **147**: 320.
- Phipps, M., Pang, T., Koh, C.L., and Puthucheary, S.** (1991). Plasmid incidence rate and conjugative chloramphenicol and tetracycline resistance plasmids n Malaysia isolates of *Salmonella typhi*. *Microbiol. Immunol.* **35**: 57-161.

**Prentki, P., Teter, B., Chandler, M., and Galas, D.J.** (1986). Functional promoters created by the insertion of transposable element IS1. *J. Mol. Biol.* **191**: 383-393.

**Rådström, P., and Swedberg, G.** (1988). RSF1010 and a conjugative plasmid contain *sull*, one of two known genes for plasmid-borne sulfonamide resistance dihydropteroate synthase. *Antimicrob. Agents Chemother.* **32**: 1684-1692.

**Recchia, G.D., and Hall, R.H.** (1995). Plasmid evolution by acquisition of mobile gene cassettes: plasmid pIE723 contains the *aadB* gene cassette precisely inserted at a secondary site in the IncQ plasmid RSF1010. *Mol. Microbiol.* **15**: 179-187.

**Recchia, G.D., and Hall, R.M.** (1995). Gene cassettes: a new class of mobile element. *Microbiol.* **141**: 3015-3027.

**Recchia, G.D., Stokes, H.W., and Hall, R.M.** (1994). Characterization of specific and secondary recombination sites recognised by the integron DNA integrase. *22 (II)*: 2071-2078.

**Rowe, B., Threlfall, E.J., and Ward, L.R.** (1987). Does chloramphenicol remain the drug of choice for typhoid. *Epidemiol. Infect.* **98**: 379-383.

**Rowe, B., Ward, L.R., and Threlfall, E.J.** (1991). Treatment of multiresistant typhoid fever. *Lancet.* **336**: 1065-1066.

**Rubens, C.E., Farrar Jr., W.E., McGee, Z.A., and Schaffner, W.** (1981). Evolution of a plasmid mediating resistance to multiple antimicrobial agents during a prolonged epidemic of nosocomial infections. *J. Infect. Dis.* **143**: 170-181.

**Salyers, A.A., and Whitt, D.D.** (1994). *Bacterial Pathogenesis: a molecular approach* (eds). A.S.M. Press, Washington, D.C.

**Salyers, A.A., and Shoemaker, N.B.** (1994). Broad host range gene transfer: Plasmids and conjugative transposons. *FEMS Microbiol. Eco.* **15 (1-2)**: 15-22.

**Sambrook, J., Fritsch, E.F., and Maniatis, T.** (1989). Molecular Cloning: A Laboratory Manual, 2<sup>nd</sup> ed. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.

**Sanger, F., Nicklen, S., and Coulson, A.R.** (1977). DNA sequencing with chain-terminating inhibitors. Proc. Natl. Acad. Sci. USA **74**: 5463-5467.

**Schatz, A., Bugie, E., and Waksman, S.A.** (1944). Streptomycin, a substance exhibiting antibiotic activity against Gram-negative and Gram-positive bacteria. Proc. Soc. Exp. Biol. Med. **55**: 66-69.

**Scherzinger, E., Bagdasarian, M.M., Scholz, P., Lurz, R., and Bagdasarian, R.M.** (1984). Requirement for three plasmid encoded proteins. Proc. Natl. Acad. Sci. USA. **81**: 654-658.

**Scherzinger, E., Haring, V., Lurz, R., and Otto, S.** (1991). Plasmid RSF1010: DNA replication *in vitro* promoted by purified RSF1010 RepA, RepB, and RepC proteins. Nuc. Acids Res. **19**: 1203-1211.

**Schmidt, F.** (1984). The role of insertions, deletions, and substitutions in the evolution of R6 related plasmids encoding aminoglycoside transferase ANT(2"). Mol. Gen. Genet. **194**: 248-259.

**Schmidt, F., and Klopfer-Kaul, J.** (1984). Evolutionary relationship between Tn21-like elements and pBp201, a plasmid from *Klebsiella pneumoniae* mediating resistance to gentamicin and eight other drugs. Mol. Gen. Genet. **197**: 248-259.

**Schmidt, F.R.J., Nückgen, E.J., and Henschke, R.B.** (1989). Structure and function of hot spots providing signals for site-directed specific recombination and gene expression in Tn21 transposons. Mol. Microbiol. **3**: 1545-1555.

**Schmitt, R.** (1986). Molecular biology of transposable elements. J. Antimicrob. Chemother. **18 (Suppl C)**: 25-34.

- Scholz, P., Haring, V., Wittmann-Liebold, B., Ashman, K., Bagdasarian, M., and Scherzinger, E.** (1989). Complete nucleotide sequence and gene organization of the broad-host-range plasmid RSF1010. *Gene*. **75**: 271-288.
- Schwalbe, R.S., Hoge, C.W., Morris, J.G. Jr., O'Hanlon, P.N., Crawford, R.A., and Gillian, P.H.** (1990). *In vivo* selection of transmissible drug resistance in *Salmonella typhi* during antimicrobial therapy. *Antimicrob. Agents Chemother.* **34**: 161-163.
- Segal, H., and Elisha, B.G.** (1997). Identification and characterization of an *aadB* gene cassette at a secondary site in a plasmid from *Acinetobacter*. *FEM Microb. Letter*. **153**: 321-326.
- Shears, P.** (1993). A review of bacterial resistance to antimicrobial agents in tropical countries. *Ann. Trop. Paed.* **13** (3): 219-226.
- Shimizu, K., Kumada, T., and Hsieh, W.-C.** (1985). Comparison of aminoglycoside resistance patterns in Japan, Formosa, Korea, Chile, and the United States. *Antimicrob. Agents Chemother.* **28**: 282.
- Silver, L.L., and Bostian, K.A.** (1993). Discovery and development of new antibiotics: the problem of antibiotic resistance. *Antimicrob Agents Chemother.* **37**: 377-383.
- Smith, J.T., and Lewin, C.S.** (1993). Mechanisms of antimicrobial resistance and implications for epidemiology. *Vet. Microbiol.* **35** (3-4): 233-242.
- Smith, J.T., and Lewin, C.S.** (1993). Mechanisms of antimicrobial resistance and implications for epidemiology. *Vet. Microbiol.* **35** (3-4): 233-242.
- Southern, E.M.** (1975). Detection of specific sequences among DNA fragments separated by gel electrophoresis. *J. Mol. Biol.* **98**: 503-517.

**Spotts, C.R., and Stanier, R.Y.** (1961). Mechanism of streptomycin action on bacteria: a unitary hypothesis. *Nature*. **192**: 633-637.

**Stokes, H.W., and Hall, R.M.** (1989). A novel family of potentially mobile DNA elements encoding site-specific gene-integration functions: integrons. *Mol. Microbiol.* **3**: 1669-1683.

**Stokes, H.W., and Hall, R.M.** (1989). A novel family of potentially mobile DNA elements encoding site-specific gene-integration functions:integrons. *Mol. Microbiol.* **3 (12)**: 1669-1683.

**Stokes, H.W., and Hall, R.M.** (1989). A novel family of potentially mobile DNA elements encoding site-specific gene integration functions:integrons. *Mol. Microbiol.* **3**:1669-1683.

**Sundström, L., Jansson, C., Bremer, K., Heikkila, E., Liljequist, B.O., and Sköld, O.** (1995). A new *dhfr VIII* trimethoprim-resistance gene, flanked by IS26, whose product is remote from other dihydrofolate reductases in parsimony analysis. *Gene* **154**: 7-14.

**Sundström, L., Rådström, P., Swedberg, G., and Sköld, O.** (1988). Site-specific recombination promotes linkage between trimethoprim-and sulfonamide- resistance genes. Sequence characterization of *dhfrV* and *sull* and a recombination active locus of Tn21. *Mol. Gen. Genet.* **213**: 191-201.

**Sundström, L., Swedberg, G., and Sköld, O.** (1993). Characterization of transposon Tn5086, carrying the site-specifically inserted gene *dhfrVII* mediating trimethoprim resistance. *J. Bacteriol.* **175**: 1796-1805.

**Swedberg, G.** (1987). Organization of two sulfonamide resistance genes on plasmids of Gram-negative bacteria. *Antimicrob. Agents. Chemother.* **31**: 306-311.

**Tanaka, M., Yamamoto, T., and Sawai, T.** (1983). Evolution of complex resistance transposons from an ancestral mercury transposon. *J. Bacteriol.* **153 (3)**: 1432-1438.

**Taylor, D.E., and Levine, J.G.** (1980). Studies on temperature-sensitive transfer and maintenance of H incompatibility group plasmids. *J. Gen. Microbiol.* **116**: 475-484.

**Thompson, C.J., and Gray, G.S.** (1983). Nucleotide sequence of a steptomycete aminoglycoside phosphotransferase gene and its relationship to phosphotransferases encoded by resistance plasmids. *Proc. Natl. Acad. Sci. USA.* **80**: 5190-5194.

**Threlfall, E.J., Rowe, B., and Ward, L.R.** (1991). Occurrence and treatment of multi-resistant *Salmonella typhi* in the U.K. *PHLS Microbiol. Digest.* **8**: 56-91.

**Threlfall, E.J., Ward, L.R., Rowe, B., Raghupathi, S., Chandrasekaran, V., Vandepitte, J., and Lemmens, P.** (1992). Widespread occurrence of multiple drug-resistant *Salmonella typhi* in India. *Eur. J. Clin. Microbiol. Infect. Dis.* **11 (II)**: 990-993.

**Trevors, J.T., Barklay, T., and Bourquin, A.W.** (1987). Gene transfer among bacteria in soil and aquatic environments: a review. *Can. J. Microbiol.* **33**: 191-198.

**Vieira, J., and Messing, J.** (1982). The pUC plasmids and M13mp7-derived system for insertion mutagenesis and sequencing with synthetic universal primers. *Gene* **19**: 259-268.

**Wallace, B.J., and Davies, B.D.** (1973) Cyclic blockade of initiation sites by streptomycin-damaged ribosomes in *Escherichia coli*: An explanation for dominance of sensitivity. *J. Mol. Biol.* **75**: 377-390.

**Wallace, B.J., Tai, P.-C., and Davis, B.D.** (1973a). Effect of streptomycin on the response of *Escherichia coli* ribosomes to the dissociation factor. *J. Mol. Biol.* **75**: 391-400.

**Wallace, B.J., Tai, P.-C., Herzog, E.L., and Davis, B.D.** (1973b). Partial inhibition of polysomal ribosomes of *Escherichia coli* by streptomycin. *Proc. Natl. Acad. Sci., USA.* **70**:1234-11237.

**Ward, E., and Grinsted, J.** (1987). The nucleotide sequence of the *mpA* gene of Tn21. *Nucl. Acids Res.* **15**: 1799-1806.

**Watanabe, T.** (1963). Infective heredity of multiple drug resistance in bacteria. *Bacteriol. Rev.* **27**: 87-115.

**Weisblum, B., and Davis, B.D.** (1968). Antibiotic inhibitors of the bacterial ribosome. *Bacteriol. Rev.* **32**: 493.

**Wiedemann, B., Meyer, J.F., and Zuhlsdorf, M.T.** (1987). Insertion of resistance genes into Tn21-like transposon. *J. Antimicrob. Chemother.* **18 (Suppl. C)**: 85-92.

**Willets, N.S.** (1980). The conjugation system of F-like plasmids. *Ann. Rev. Genet.* **14**: 41-76.

**Willets, N.S., and Crowther, C.** (1981). Mobilization of the non-conjugative IncQ plasmid RSF1010. *Genet. Res.* **37**: 311-316.

**Willets, N.S., and Skurray, R.** (1980). The conjugative system of F-like plasmids. *Annu. Rev. Genet.* **14**: 41-76.

**Willets, N.S., and Wilkins, B.M.** (1984). Processing of plasmid DNA during bacterial conjugation. *Microbiol. Rev.* **48**: 24-41.

**Wohlleben, W., Arnold, W., Bissonnette, L., Pelletier, A., Tanguay, A., Roy, P.H., Gamboa G.C., Barry, G.F., Auber, E., Davies, J., and Kagan, S.A.** (1989). On the evolution of the Tn21-like multiresistance transposons: sequence analysis of the gene (*aacC1*) for gentamicin acetyltransferase-3-I(AAC(3)-I), another member of the Tn21-based expression cassette. *Mol. Gen. Genet.* **217**: 202-208.

**Wong, H.L., Lim, M.E., Sam, C.K., and Koh, C.L.** (1996). Molecular cloning of the ampicillin resistance gene of a multiple antibiotic resistance transposon from *Salmonella typhi*. In Proceedings of The Second National Congress on Genetics (Eds.

Mohamad Osman, Mahani Mansor Clyde, and Zulkeflie Zamrod), pp. 291-292. Genetics Society of Malaysia, Kuala Lumpur.

**Wong, S.W.** (1991). Conjugative R Plasmids from Two Chloramphenicol and Tetracycline Resistant *Salmonella typhi* Strains. B.Sc. (Hons.) thesis, session 1990/91, Department of Genetics and Cellular Biology, University of Malaya.

**Woodward, T.E., Smadel, J.E., Ley, H.L. Jr., Green, R., and Mankikar, D.S.** (1948). Preliminary report on the beneficial effect of chloromycetin in the treatment of typhoid fever. Ann. Intern. Med. 29: 131-134.

**Yanisch-Perron, C., Vieira, J., and Messing, J.** (1985). Improved M13 phage cloning vectors and host strains: nucleotide sequences of the M13mp18 and pUC19 vectors. Gene 33: 103-119.