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Physical Map Location of the New *artPIQMJ* Genes of *Escherichia coli*, Encoding a Periplasmic Arginine Transport System

ULRICH WISSENBACH, BIRGIT KECK, AND GOTTFRIED UNDEN*

Institut für Biochemie, Heinrich Heine Universität, Universitätsstrasse 1, 4000 Düsseldorf, Germany

The *artPIQMJ* genes encode a periplasmic transport system that mediates arginine uptake by *Escherichia coli*. Sequencing of the region revealed five contiguous genes (*artPIQMJ*) (11). The *artPQMJ* genes each have similar counterparts in the *hisJQMP* operon of both *Salmonella typhimurium* and *E. coli*, which encodes the periplasmic histidine transport system (2, 3, 6), and were named correspondingly. The product of the *artI* gene is very similar to that of *artJ*. The periplasmic binding protein encoded by *artJ* binds arginine with high affinity (11). The similar *hisPM* genes of *E. coli* located at 50 min on the *E. coli* genetic map (1, 6), can be differentiated from the *art* system by different nucleotide sequences and by different substrate specificities of the corresponding periplasmic binding proteins.

A restriction map of the cloned region was obtained by restriction with eight enzymes and by analysis of the nucleotide sequence, yielding the physical map shown in Fig. 1. The restriction pattern corresponds to that of the Kohara map of the *E. coli* chromosome at 909.5 to 922 kbp (5, 8); other fits were not possible. The map contains four restriction sites not mentioned in the map of Kohara et al. (an *Eco*RV site at 913.8 kbp, a *Bgl*I site at 912.0 kbp, and *Pvu*II sites at 916.0 and 916.3 kbp). The absence of these sites from the map of Kohara et al. may be due to the small size of the generated fragments (0.1 to 0.6 kbp). A further difference is an inversion of the *Eco*RV site at 913 kbp and of the *Pvu*II site at 913.5 kbp (8). These sites are only 20 bp apart, and their relative positions were determined from the nucleotide sequence. The orientation of the genes is counterclockwise.

The position of the *artPIQMJ* genes on the chromosome was confirmed by using a gene-mapping membrane, which contains a set of the DNA spots from 476 lambda phages. The phages carry the entire *E. coli* genome in overlapping fragments (5, 9). A DNA fragment (1.4-kbp *Hin*dII fragment) (Fig. 1) consisting of *artJ* and part of *artM* was used as a probe for hybridization. The probe hybridized to DNA from phage 14H6 of the set but not to the adjacent clones to the right or to the left (5F4 and 1E5, respectively) or to any other clone. This result is in agreement with the localization obtained by restriction mapping (Fig. 1). The position corresponds to approximately 19.1 to 19.3 min on the genetic map of *E. coli* (1, 5). The position is quite close to but is different from that of a periplasmic putrescine transport system, the genes of which hybridize with phage clone 5F4 (4), and is close to the *poxB* gene, which maps at 19 min on the *E. coli* map (7, 10).

Nucleotide sequence accession numbers. The nucleotide sequences of the *artPIQMJ* genes have been assigned the EMBL and GenBank nucleotide sequence database accession numbers X67753 (*artIQMJ*) and X69108 (*artP*).

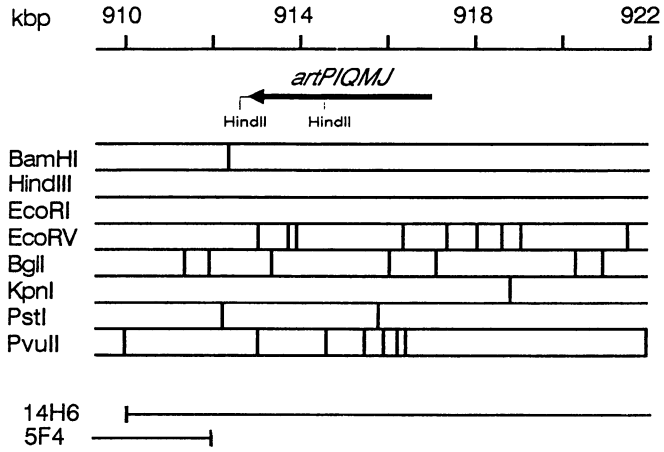

FIG. 1. Restriction map of the *artPIQMJ* region of the *E. coli* K-12 chromosome generated with eight restriction enzymes. The upper line gives the map units of the chromosome in kilobase pairs (5). The arrow indicates the size and the transcriptional polarity of the *artPIQMJ* genes. The *Hin*dII fragment of the *artPIQMJ* genes was used as a hybridization probe. Below the restriction map the chromosomal fragments of the phages 14H6 and 5F4 are aligned (5).

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REFERENCES

1. **Bachmann, B. J.** 1990. Linkage map of *Escherichia coli* K-12, edition 8. Microbiol. Rev. **54**:130–197.
2. **Higgins, C. F., and G. F.-L. Ames.** 1981. Two periplasmic proteins which interact with a common membrane receptor show extensive homology: complete nucleotide sequences. Proc. Natl. Acad. Sci. USA **78**:6038–6042.
3. **Higgins, C. F., P. D. Haag, K. Nikaido, F. Ardeshir, G. Garcia, and G. F.-L. Ames.** 1982. Complete nucleotide sequence and identification of membrane components of the histidine transport operon of *Salmonella typhimurium*. Nature (London) **298**: 723–727.
4. **Kashiwaji, K., N. Hosokawa, T. Furuchi, H. Kobayashi, C. Sasakawa, M. Yoshikawa, and K. Igaraski.** 1990. Isolation of polyamine transport-deficient mutants of *Escherichia coli* and cloning of the genes for polyamine transport proteins. J. Biol. Chem. **265**:20893–20897.
5. **Kohara, Y., K. Akiyama, and K. Isono.** 1987. The physical map of the whole *E. coli* chromosome: application of a new strategy for rapid analysis and sorting of a large genomic library. Cell **50**:495–508.
6. **Kraft, R., and L. A. Leinwand.** 1987. Sequence of the complete

* Corresponding author.

P protein and part of the M protein gene from the histidine transport operon of *Escherichia coli* compared to that of *Salmonella typhimurium*. Nucleic Acids Res. **15:**8568.

7. **Kröger, M., R. Wahl, and P. Rice.** 1991. Compilation of DNA sequences of *Escherichia coli* (update 1991). Nucleic Acids Res. **19:**2023–2043.
8. **Médigue, C., J. P. Bouché, A. Hénaut, and A. Danchin.** 1990. Mapping of sequenced genes (700 Kbp) in the restriction map of *Escherichia coli* chromosome. Mol. Microbiol. **4:**169–187.
9. **Noda, A., J. B. Courtright, P. F. Denor, G. Webb, Y. Kohara, and A. Ishihama.** 1991. Rapid identification of specific genes in *E. coli* by hybridization to membranes containing the ordered set of phage clones. BioTechiques **10:**474–477.
10. **Rudd, K. E., W. Miller, C. Werner, J. Ostell, C. Tolstoshev, and S. G. Satterfield.** 1991. Mapping sequenced *E. coli* genes by computer: software, strategies and examples. Nucleic Acids Res. **19:**637–647.
11. **Wissenbach, U., and G. Unden.** 1992. Unpublished results.