

## Molecular Weights of DNA from Bacteriophages T5, T5st(0), BF23, and BF23st(4)

DIMITRIJ LANG,\* ALAN R. SHAW,<sup>1</sup> AND D. JAMES McCORQUODALE<sup>1</sup>

*Molecular Biology Program, The University of Texas at Dallas, Richardson, Texas 75080*

Received for publication 8 August 1975

The DNA molecular weights were determined by calibrated electron microscopy. The results (in units of  $10^6$ ) are: for T5,  $77.4 \pm 2.4$ ; T5st(0),  $72.4 \pm 1.9$ ; BF23,  $76.7 \pm 2.3$ ; and BF23st(4),  $71.4 \pm 1.7$ .

Various authors have determined the molecular weights of DNA from the related coliphages T5 and BF23. Differences in the results (see Table 2 in reference 2, and 6) may in part be attributed to differences in the phage stocks themselves and it seemed useful to redetermine the DNA molecular weights for the particular phage stocks which have been used extensively in this institution, including two heat-stable deletion mutants, T5st(0) and BF23st(4).

Electron microscopy of DNA molecules pre-

Three of the bacteriophages were originally obtained from S. E. Luria (T5), Y. T. Lanni [T5st(0)], and M. Nomura (BF23). BF23st(4) was isolated by A. R. Shaw and D. J. McCorquodale as a surviving buoyant-density mutant from heat-treated BF23 (3). The DNA was isolated and purified by phenol (C. W. Chen, Ph.D. thesis, Univ. of Texas at Dallas, 1975) and sampled for electron microscopy from 0.20 M ammonium chloride, pH 5, by the spontaneous-adsorption method (5). Magnifications were

TABLE 1. Lengths and molecular weights<sup>a</sup>

DNA from:	No. of molecules	Length ( $\mu\text{m}$ )	$\pm$ SSD ( $\mu\text{m}$ )	$\pm$ SDM ( $\mu\text{m}$ )	Mol wt ( $10^6$ )
T5	52	36.90	1.04	0.14	$77.4 \pm 2.4$
	32	38.42	1.14	0.20	
	34	37.01	1.00	0.17	
T5st(0)	32	35.65	0.83	0.15	$72.4 \pm 1.9$
	19	34.69	0.75	0.17	
	18	34.58	0.31	0.07	
BF23	42	37.03	0.83	0.13	$76.7 \pm 2.3$
BF23st(4)	33	34.11	0.58	0.10	$71.4 \pm 1.7$
	29	34.80	0.80	0.15	

<sup>a</sup> SSD, Sample standard deviation; SDM, standard deviation of the mean. SSD between the independently measured length and molecular weights are: for T5,  $37.4 \pm 0.9$ ,  $77.4 \pm 2.4$ , respectively; T5st(0),  $35.0 \pm 0.6$ ,  $72.4 \pm 1.9$ , respectively; and BF23st(4),  $34.5 \pm 0.5$ ,  $71.4 \pm 1.7$ .

pared under standard conditions yields accurate lengths (L) which are proportional to their molecular weight (M). The proportionality factor is the molar linear density of duplex DNA under standard conditions and has been calibrated with T7 DNA (4) of reliably known molecular weight (1). Thus,

$$M = (2.07 \pm 0.04) \times 10^{10} L_{(\text{cm})}. \quad (1)$$

<sup>1</sup> Present address: Department of Biochemistry, Medical College of Ohio, Toledo, Ohio 43614.

calibrated and the molecules were measured as described (4).

The error of the molecular weight as indicated is the geometric sum of the error of the molar linear density (see equation 1) and the sample standard deviation between the measured length averages (Table 1). The DNAs from T5 and BF23 phages are identical in size within the error limits of about  $\pm 3\%$ . The deletion in T5st(0) DNA is  $2.4 \pm 1.1 \mu\text{m}$ , that is  $6.4 \pm 2.9\%$  of the T5 DNA corresponding to  $5.0 \pm 2.3 \times 10^6$

daltons. This compares well with the value of 5.6% measured by heteroduplex mapping (6). The deletion in BF23st(4) DNA is  $2.5 \pm 1.0 \mu\text{m}$ , that is  $6.8 \pm 2.7\%$  of the BF23 DNA corresponding to  $5.2 \pm 2.1 \times 10^6$  dalton.

We are grateful to Lester Lewis, Jr., Barbara Bruton, and Alexander Lang for assistance.

This research was supported by Public Health Service research grants GM 34964 and GM 20851 from the National Institute of General Medical Science, and by the National Science Foundation, grant GB 43818.

#### LITERATURE CITED

1. Freifelder, D. 1970. Molecular weights of coliphages and coliphage DNA. IV. Molecular weights of DNA from bacteriophages T4, T5 and T7 and the general problem of determination of M. J. Mol. Biol. **54**:567-577.
2. Hayward, G. S., and M. G. Smith. 1972. The chromosome of bacteriophage T5. I. Analysis of the single-stranded DNA fragments by agarose gel electrophoresis. J. Mol. Biol. **63**:383-395.
3. Hertel, R. L., L. Marchi, and K. Müller. 1962. Density mutants of phage T5. Virology **18**:576-581.
4. Lang, D. 1970. Molecular weights of coliphages and coliphage DNA. III. Contour length and molecular weight of DNA from bacteriophages T4, T5 and T7, and from bovine papilloma virus. J. Mol. Biol. **54**:557-565.
5. Lang, D., and M. Mitani. 1970. Simplified quantitative electron microscopy of biopolymers. Biopolymers **9**:373-379.
6. Scheible, P. P., and M. Rhoades. 1975. Heteroduplex mapping of heat-resistant deletion mutants of bacteriophage T5. J. Virol. **15**:1276-1280.