Report

**DRUG RESISTANCE OF *ESCHERICHIA COLI* STRAINS
ISOLATED FROM CHICKEN**

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Two hundred and eighty-seven drug-resistant strains of *Escherichia coli* were isolated from 150 ground meat samples of chicken purchased at markets in 1978, and 210 R plasmids were demonstrated in those strains.

The most frequent resistance pattern (88%) included SA or TC resistance. The pattern associated with SM resistance was secondly frequent and the frequency of CM resistance was as low as 20%. In relation to TC, CM, SM, and SA, the isolation frequency was the highest with strains triple resistant to any combination of three of four drugs. Among the resistant *E. coli* strains, R plasmids with single resistance to each of four drugs and those accompanying KM or APC resistance were most frequently demonstrated.

The use of antibiotics has brought many advantages to the livestock industry. The drugs not only cure the animals of bacterial infections but also accelerate growth and the increase in the body size. However, long-term administration of antibiotics has brought an increase in the number of drug-resistant organisms, especially those with conjugally transferable resistance. This paper deals with the studies on the distribution of drug resistance plasmids among *E. coli* strains isolated from chickens purchased at commercial markets.

We isolated 287 *E. coli* strains resistant to any one or any combination of the drugs tested, i.e., TC, CM, SM, SA, KM and APC. Drug-resistant *E. coli* strains were isolated from all chicken materials tested. SA- and TC-resistant strains were isolated most frequently (87.8% and 87.5%, respectively), followed by SM-(68.6%) and KM-resistant ones (41.8%). The isolation frequencies of CM- and APC-resistant strains were very low, being 22.0% and 22.3%, respectively.

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TABLE I

Resistance patterns of E. coli strains isolated from chicken

Rasistance patterns ^a	Isolation frequency (%)		Number of R ⁺ strains (%)	
Quadruple	TC. CM. SM. SA	51 (17.8)	33	(64.7)
Triple	TC. SM. SA	111 (38.7)	64	
	TC. CM. SA	7 (2.4) (42.5)	6	73 (59.8)
	TC. CM. SM	1 (0.4)	1	
	CM. SM. SA	3 (1.0)	2	
Double	TC. SA	49 (17.1)	20	
	TC. SM	17 (5.9) (27.5)	11	35 (44.3)
	SM. SA	13 (4.5)	4	
Single	SA	18 (6.2)	4	
	TC	15 (5.2) (12.2)	4	10 (28.6)
	CM	1 (0.4)	1	
	SM	1 (0.4)	1	
Total number of strains		287	151	(52.6)

^a In relation to resistance to TC, CM, SM and SA.

One hundred and fifty ground meat samples of chicken were purchased from 100 meat-shops in Niigata and Takamatsu cities in 1978. Fifty *Escherichia coli* strains were isolated from each sample and drug resistance of these strains was determined by the replica plating method using the heart infusion (HI) agar plate containing each of the drugs, i. e., tetracycline (TC, 12.5 µg/ml), chloramphenicol (CM, 12.5 µg/ml), streptomycin (SM, 12.5 µg/ml), kanamycin (KM, 25.0 µg/ml) and ampicillin (APC, 25.0 µg/ml). A semisynthetic medium (Devis *et al.*, 1950) was used for the determination of SA resistance; the criteria for resistance was 100 µg/ml of SA. One *E. coli* strain was picked from the strains carrying the same resistance pattern isolated from each meat sample. Thus, total of 287 drug-resistant *E. coli* strains was collected.

TABLE II

Demonstration frequency of KM- and APC-resistant E. coli strains in relation to resistance to TC, CM, SM and SA

Resistance ^a patterns	Number of strains	Number of strains resistant to (%)	
		KM	APC
Quadruple	51	25 (49.0)	17 (33.3)
Triple	122	59 (48.4)	33 (27.0)
Double	79	31 (39.2)	13 (16.5)
Single	35	5 (14.3)	1 (2.9)
Total number of strains	287	120 (41.8)	64 (22.3)

^a In relation to resistance to TC, CM, SM and SA.

Resistance patterns of *E. coli* strains to TC, CM, SM and SA are shown in Table I. Triply resistant strains were isolated most frequently (42.5%), followed by doubly, quadruply and singly resistant ones. Among triply resistant strains, (TC.SM.SA)-resistant ones were most frequently seen.

Demonstration frequencies of KM- and APC-resistant strains in relation to the resistance to TC, CM, SM and SA are shown in Table II. KM-resistant strains were demonstrated most frequently among quadruply and triply resistant ones (about 49%), followed by doubly and singly resistant ones, indicating that KM-resistance was demonstrated among the strains carrying multiple resistance.

TABLE III
Resistance patterns of R plasmids

Resistance patterns	Number of plasmids (%)	
TC. CM. SM. SA	17	(8, 1)
TC. SM. SA	10	
CM. SM. SA	3	
TC. CM. SM	1	
TC. SM. SA. KM	3	22 (10. 5)
TC. CM. SA. APC	2	
TC. SM. SA. APC	1	
TC. SM. SA. KM. APC	2	
SM. SA	16	
TC. SM	14	
TC. SA	5	
CM. SA	1	
SM. SA. KM	8	
TC. SM. KM	6	
TC. SA. KM	3	70 (33. 3)
SM. SA. APC	2	
TC. SM. APC	2	
TC. CM. APC	1	
SM. SA. KM. APC	6	
TC. SA. KM. APC	3	
TC. SM. KM. APC	2	
CM. SA. KM. APC	1	
SA	21	
KM	16	
TC	11	
CM	4	
SM	4	
SM. KM	14	
SA, KM	10	101 (48. 1)
TC. KM	2	
TC. APC	1	
KM. APC	3	
TC. KM. APC	5	
SM. KM. APC	7	
CM. KM. APC	3	

Two substarains of *E. coli* K12 ML1410 (*met nal^r F⁻*) (*nal^r*, resistant to nalidixic acid) and *E. coli* W3630 were used as the recipients of R plasmid transfer. Conjugal transfer of drug resistance was performed by the method reported previously (Tanaka et al., 1969).

Demonstration frequencies of APC-resistant strains in relation to the aforementioned four drugs were similar to those carrying KM-resistance. KM- and APC-resistant strains were frequently demonstrated among multiple-resistant ones compared with singly resistant ones in relation to resistance to TC, CM, SM and SA.

R plasmids carrying KM-resistance were isolated from 71 strains among 120 KM-resistant ones (59.2%). Of 64 APC-resistant strains, 31 (48.4%) carried R plasmids encoding APC-resistance.

We isolated 210 R plasmids (73%) from 287 drug-resistant *E. coli* strains. Resistance patterns of R plasmids are shown in Table III. R plasmids carrying single resistance to TC, CM, SM or SA or those accompanying KM or APC resistance were isolated most frequently (48.1%), followed by those encoding double, triple and quadruple resistance to one and any combination of two or three of TC, CM, SM and SA in that order. R plasmids encoding resistance to KM, APC or (KM.APC) were also isolated at high frequencies accompanying triple and double resistance to any combination of two and three of TC, CM, SM and SA. It should be noted that R plasmids with single resistance were most frequently demonstrated with the isolates from chicken compared with those of clinical isolates from human beings (Mitsuhashi, 1977).

The R plasmids showed other distinct resistance patterns compared with those of *E. coli* or *Shigella* isolated from human being (Tanaka, Tsunoda and Mitsuhashi, 1969, 1973; Tanaka *et al.*, 1974). The results described in this article show the contamination of chicken meat with drug-resistant *E. coli* strains probably from fowls. From these resistant *E. coli* strains, R plasmids were isolated at high frequencies, suggesting a high frequency of R plasmid transfer from fowl to fowl on farms. The high contamination rate of chicken meat with *E. coli* strains carrying R plasmids tells us the necessity for taking public health precaution in animal husbandry.

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