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Escherichia coli serotype distribution in man and animals

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SUMMARY

The serotype distributions of *Escherichia coli* isolated from animal faeces, human faeces and from meat have been compared. There were marked differences in serotype distribution in strains from man and animals. The meat strains generally resembled animal strains. The results suggest either that animal strains of *E. coli* are not reaching the general human population outside hospital to any great extent, or, if they do so, are failing to implant in the bowel.

INTRODUCTION

It has previously been suggested that animal strains of *Escherichia coli* regularly reach the human population via food (Cooke *et al.* 1970) and may implant in the human bowel (Shooter *et al.* 1970). In the present work, strains of *E. coli* previously isolated were typed using full O and H serotyping facilities. This was done in an attempt to determine whether animal and human strains of *E. coli* fall into distinct groups, or whether there is a serological overlap between *E. coli* strains from the two sources.

MATERIALS AND METHODS

Rectal swabs were obtained from cattle and pigs slaughtered in an abattoir and from chickens in a poultry packing station, as described by Cooke *et al.* (1970). Forty-eight specimens of meat were examined. These included beef, veal, poultry and pork. The meat was taken either from the hospital kitchen or from the homes of members of the laboratory staff. Preliminary work having shown that *E. coli* contamination of meat was confined to the surface, the meat was sampled by rubbing a swab over its surface. Faecal specimens were obtained from 55 persons; 7 from hospital staff and 48 from normal people outside the hospital. The specimens were plated on MacConkey's medium and 5 to 10 colonies of each colonial type examined. *E. coli* were identified as previously (Cooke, Ewins & Shooter, 1969). The strains of *E. coli* were serotyped using 150 O antisera and 51 H antisera

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Table 1. *Numbers of strains examined and serotyped from different specimens*

Source of strains	No. of specimens	No. of colonies examined	No. of different serotypes isolated from each source
Animals			
Cattle	38	274	139
Chickens	18	87	76
Pigs	11	65	60
Meat			
Beef and veal	25	52	36
Poultry	17	71	63
Pork	6	21	13
Persons			
Faeces	55	506	116

Table 2. *Distribution of O typable, non-typable and rough strains*

	Sources of strains						
	Animals			Meat			Humans
Types of strains	Cattle	Chickens	Pigs	Beef or veal	Poultry	Pork	Faeces
No. typable (150 O sera)	42	32	17	15	34	3	77
No. smooth but not O typable	66	34	33	18	24	4	14
No. O rough	31	10	10	3	5	6	25
Total	139	76	60	36	63	13	116

Table 3. *Distribution of H typable, non-typable and non-motile strains*

	Sources of strains						
	Animals			Meat			Humans
Types of strains	Cattle	Chickens	Pigs	Beef or veal	Poultry	Pork	Faeces
No. of typable (51 H sera)	126	57	41	25	43	7	71
No. motile but not typable	5	3	11	9	11	6	5
No. non-motile	8	16	8	2	9	0	40
Total	139	76	60	36	63	13	116

by tube agglutination based on methods previously described (Bettelheim & Taylor, 1969).

RESULTS

The number of specimens obtained, of *E. coli* examined and of the different serotypes found are given in Table 1.

The distribution of the typable, non-typable, rough and non-motile strains is given in Tables 2 and 3, and the distribution of common urinary infecting serotypes in Table 4.

Table 4. *Occurrence of common urinary serotypes in strains from the various sources*

	Sources of strains						
	Animals			Meat			Humans
Types of strains	Cattle	Chickens	Pigs	Beef or veal	Poultry	Pork	Faeces
No. of smooth strains	108	66	50	33	58	7	91
No. of common urinary serotypes (O1, O2, O4, O6, O7, O11, O18, O39 and O75)	4	3	1	8	9	1	26
% common urinary types of smooth strains	4	5	2	24	16	14	28

Table 5. *Source of O serotypes commonly associated with urinary tract infection*

Serotype	Source	Serotype	Source
O1:H6	cattle	O6:H1	humans
O1:H7	cattle, humans	O6:H16	chickens, poultry
O1:H45	poultry	O6:H45	poultry
O1:Hnt*	poultry	O6:H−	humans
O1:H−	chickens, humans	O7:H24	beef
O2:H5	beef	O7:H−	humans
O2:H6	humans	O11:H4	humans
O2:H7	cattle	O11:H16	poultry
O2:H8	cattle	O18:H7	humans
O2:H27	beef	O18:H14	cattle, beef, humans
O2:H−	beef, poultry	O18:H−	pigs, humans
O4:H1	humans	O39:Hnt*	humans
O4:H5	humans	O75:H55	humans
O4:H16	poultry	O75:H−	beef, pork, humans
O4:H42	poultry		
O4:H−	humans		

* nt, non-typable.

DISCUSSION

The number of strains which were O serotypable with the antisera used was much less among the animal population than among the human strains, with the meat strains resembling the animal strains. It was also noted that of the serotypes found, those commonly associated with urinary tract infections of humans and probably derived from the normal human faecal flora (Gruneberg, Leigh & Brumfitt, 1968) were found in relatively large numbers in the strains of human origin but rarely in the animal strains, with the meat strains falling between them (Table 4).

We have previously suggested that animal strains of *E. coli* reach the human bowel and can implant (Shooter *et al.* 1970). This is significant because of the widespread use of antibiotics in animal husbandry. It has been shown by Cooke, Hettiaratchy & Buck (1971) that the ingestion by volunteers of cultures of *E. coli*

of animal origin can result in these strains implanting in the bowel for long periods, although other workers have obtained rather different results (Williams Smith, 1969).

The difference found in the serotypes from animals and man with those from meat falling between them may reflect geographical variation in serotype distribution which has been shown to occur over quite small areas (Gruneberg & Bettelheim, 1969). All the human specimens came from people in the London area but it is possible that the results obtained with the abattoir specimens may reflect the distribution in animals from a limited number of environments. Nevertheless, the indications from this work are that the feed-through of *E. coli* from animals to man may be limited in the general population and that either serotypes from animals are generally not reaching the human population to any great extent, or they may not establish well in the human bowel. Most of the persons in this survey at the time of the study were eating mainly home-cooked food, that our own unpublished studies have shown usually to contain fewer *E. coli* than food served in hospitals and canteens (Shooter *et al.* 1971). The fact that a larger percentage of what are generally regarded as typically human serotypes were found in the meat strains would indicate contamination with strains of human origin during handling or selective survival of certain serotypes.

A difficulty in this work is the small amount of published material on the normal faecal flora of man and domestic animals. A large percentage of the results which are available have been obtained with limited numbers of antisera, because the authors were only looking for certain serotypes, such as the common enteropathogenic or urinary-tract-infecting serotypes. Unless a full range of O antisera is used and the numerous cross-reactions between various *E. coli* O types taken into account, an accurate interpretation of the results cannot be made because a number of O types might be grouped together.

The use of H antigen typing also indicated certain differences. Thus, on three occasions O6:H1 was isolated from human faeces but not from any of the other specimens. The only representatives of O group 6 found among the animal or meat strains were one strain of type O6:H16 from a chicken in the poultry packing station and two from chickens on arrival at the hospital kitchen.

It was also seen that for most O groups which are found in a number of different types of specimens, different H antigens appear associated with different sources. The sources of the O types which are commonly associated with urinary tract infections and their associated H antigens are shown in Table 5.

Three enteropathogenic serotypes were found: O86:H21, O114:H− and O128:H35. Two of these were found in the human faeces and the O114:H− serotype was found in a poultry packing station.

The results generally appear to indicate that there are obvious differences in serotype distribution of *E. coli* in man and animals. More work is required, particularly studying different geographical areas and *E. coli* serotype distribution in hospital patients.

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