

## The effect of diet on intestinal *Escherichia coli*

BY K. A. BETTELHEIM, E. MARY COOKE, SHEILA O'FARRELL  
AND R. A. SHOOTER

*Department of Medical Microbiology, St Bartholomew's Hospital,  
West Smithfield, London EC1A 7BE*

(Received 29 November 1976)

### SUMMARY

During an 8-week period all specimens of stool passed by six nurses were examined for the presence of *Escherichia coli* and all isolations of this organism were serotyped. During the middle 4 weeks of the period the nurses ate a sterile diet. A smaller number of serotypes was isolated during the period of sterile diet than during the period when normal food was eaten. This finding supports the view that normal food is a source of strains of *E. coli* present in the bowel. Some new serotypes of *E. coli* did appear during the period of sterile diet. The possible sources of these are discussed.

### INTRODUCTION

It has been suggested that new serotypes of *E. coli* constantly impinge on the intestine of man via food (Cooke *et al.* 1970). These strains may arise from animals and some may implant in the human bowel (Shooter, Cooke, Rousseau & Breaden, 1970). In order to assess the role of food as a source of faecal *E. coli* the faeces of six healthy adults were studied over an 8-week period during four of which the people concerned ate a sterile diet.

### MATERIALS AND METHODS

Six nurses working in the hospital helped us in these studies. Specimens of each stool passed during an 8-week period were examined. For the middle 4 weeks of the period the nurses ate exclusively a diet of tinned food and ultraheat-treated milk with vitamin supplements. All cutlery was autoclaved and disposable plates and cups were used. Tooth brushes were soaked in hydrogen peroxide and sterile water was used for cleaning the teeth. For the remaining 4 weeks of the period the nurses ate a normal diet, some of their meals being eaten in the hospital canteen.

All faecal specimens were plated on MacConkey's medium and 10 colonies representing as many different colonial variants as possible were examined. *E. coli* were identified as previously (Cooke, Ewins & Shooter, 1969). The strains of *E. coli* were serotyped using 154 O antisera and 53 H antisera by methods previously described (Bettelheim *et al.* 1975; Chandler & Bettelheim, 1974).

Table 1. *Number of serotypes found per specimen during the three periods*

Nurse	Number of serotypes found per specimen		
	Before sterile diet	During sterile diet	After sterile diet
1	1.53	0.91	2.08
2	1.71	0.61	2.46
3	0.82	0.33	1.00
4	1.21	0.57	1.50
5	1.71	0.22	3.00
6	0.90	0.43	1.00

## RESULTS

The 279 faecal specimens examined yielded 2659 isolations of *E. coli*; 142 different *E. coli* serotypes were found, which included 60 O antigens and 34 H antigens.

A large number of the serotypes isolated (109 of the 142 strains) were isolated only once from each nurse. Only 35 strains of *E. coli* were present in six or more specimens. The ratio of the number of serotypes to the number of specimens is shown in Table 1. The number of serotypes per specimen was less during the sterile diet period and rose after this period to levels higher than previously. However, a number of serotypes were isolated for the first time during the period of sterile diet.

## DISCUSSION

The smaller number of serotypes of *E. coli* isolated per specimen of faeces during the period of sterile diet supports the view that normal food is a source of strains of *E. coli* present in the bowel. However, the isolation of new serotypes of *E. coli* during the sterile diet period requires explanation. The complexity of the faecal population (Bettelheim, Faiers & Shooter, 1972) does not permit one to state that these occurred then for the first time. They may have occurred previously, but, owing to sampling difficulties, have only been demonstrated later. This is exemplified by serotype O13/O147.H52 which occurred in nurse 6 throughout the period of study but in only 20 of the 43 specimens.

The new strains may have arisen as a result of antigenic variation and evidence for the existence of complex variations has again appeared (Bettelheim *et al.* 1974). The best example of this was in nurse 2 where serotypes O1.H1; O1.H45; O68.H45; O139.H56; R.H56; O68.H56; and O106.H56 occurred in that order and persisted. The last 3 appeared first during the period of sterile diet. There also appeared during the period of study sporadic strains of O106.H4; O139.H19; O106.H-; O9.H56; Ont.H45; O68.H-; and O1.H25. The O groups O68, O106 and O139 are slightly related to each other, but can be distinguished. They are not related to O1. The H antigens are not related to each other serologically.

There is also the possibility that these new serotypes were acquired from sources other than food or that some non-sterile food was eaten.

The study again showed the great variety of *E. coli* serotypes that can be isolated from human subjects and that, as in previous studies, food is probably the most important source of these.

REFERENCES

- BETTELHEIM, K. A., BUSHROD, F. M., CHANDLER, M. E., TROTMAN, R. E. & BYRNE, K. C. (1975). An automatic method for serotyping *Escherichia coli*. *Zentralblatt für Bakteriologie, Infektionskrankheiten und Hygiene Abt. 1, Orig. A* **230**, 443-51.
- BETTELHEIM, K. A., FAIERS, M. & SHOOTER, R. A. (1972). Serotypes of *Escherichia coli* in normal stools. *Lancet* *ii*, 1224-6.
- BETTELHEIM, K. A., TEOH-CHAN, C. H., CHANDLER, M. E., O'FARRELL, S. M., RAHAMIN, L., SHAW, E. J. & SHOOTER, R. A. (1974). Further studies of *Escherichia coli* in babies after normal delivery. *Journal of Hygiene* **73**, 277-85.
- CHANDLER, M. E. & BETTELHEIM, K. A. (1974). A rapid method of identifying *Escherichia coli* H antigens. *Zentralblatt für Bakteriologie, Infektionskrankheiten und Hygiene Abt. 1, Orig. A* **229**, 74-9.
- COOKE, E. M., EWINS, S. & SHOOTER, R. A. (1969). Changing faecal population of *Escherichia coli* in hospital medical patients. *British Medical Journal* *iv*, 593-5.
- COOKE, E. M., SHOOTER, R. A., KUMAR, P. J., ROUSSEAU, S. A. & FOULKES, A. L. (1970). Hospital food as a possible source of *Escherichia coli* in patients. *Lancet* *i*, 436-7.
- SHOOTER, R. A., COOKE, E. M., ROUSSEAU, S. A. & BREADEN, A. L. (1970). Animal sources of common serotypes of *Escherichia coli* in the food of hospital patients. *Lancet* *ii*, 226-8.