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## OCCURRENCE OF ENTEROTOXIGENIC STAPHYLOCOCCI, ESPECIALLY PRODUCERS OF ENTEROTOXINS D AND E AMONG STRAINS ISOLATED FROM FOOD

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The enterotoxigenic properties of 289 strains of staphylococci isolated from various foods were investigated. Out of 77 strains isolated from the incidents of food poisoning, 53 were enterotoxigenic, producing enterotoxins: D alone; E alone; or D A; D, A and C by 7, 2, 11, 3 strains respectively.

Out of 190 strains isolated from market-food, 44 were enterotoxigenic. Among them 5 strains produced enterotoxin D alone, 9 strains produced enterotoxins A and D and one — enterotoxine A, C and D.

### INTRODUCTION

In Poland, as in many other countries, staphylococcal food-poisoning belongs to the most common incidents of food-poisoning.

This poisoning is due to the action of staphylococcal enterotoxins. Till now, five serologically distinct staphylococcal enterotoxins: A, B, C, D and E, have been isolated and determined.

The occurrence of enterotoxins A, B, C and D among the strains of staphylococci was the subject of investigations of Casman, Bennet, Dorsey and Issa [5]. Out of the 80 strains isolated from foods involved in food-poisoning incidents, 96.2% strains were enterotoxigenic. 7.6% of them produced enterotoxin D, 25% enterotoxin A and D. Out of the 256 strains isolated from raw milk, 10% were enterotoxigenic, 6% produced the enterotoxin D.

Simkovicova and Gilbert [9] similarly found, that 92% out of the strains isolated from cases of food-poisoning were enterotoxin-producers.

In the investigations of Oswath-Marton and Danjan [6] out of the 101 strains isolated from foods responsible for food-poisoning — 83,2% produced one or two enterotoxins. Some of the inspected strains that failed

to produce enterotoxins A, B and C were tested for the production of enterotoxin E, but without positive result.

Wieneke [11] studied the ability to produce enterotoxins of the strains isolated during the routine bacteriological examination of foods. The enterotoxigenic strains isolated from meat and poultry produced mostly the enterotoxin D. The enterotoxins A, B, C and E were produced rather unfrequently. Out of the 113 strains isolated from cheese and raw milk — 11% were enterotoxigenic. Only few strains isolated from food produced enterotoxin E.

In England, the occurrence of various enterotoxins among the strains of staphylococci isolated from food was recently the subject of the investigations of Payne and Wood [7]. They found 5% of enterotoxin D producers, 7,5% of enterotoxin A and D producers and only 1% of enterotoxin E — producers.

In Poland, the production of distinct enterotoxins by *S. aureus* strains from various sources was studied by Burbianka [3]. She determined the ability of the 340 strains to produce enterotoxins A, B and C. Enterotoxin D production was studied only in 92 strains. 7 strains produced this toxin, always in association with enterotoxin A or B.

## MATERIALS AND METHODS

The material consisted of *Staphylococcus aureus* strains, received from 13 Sanitary-Epidemiological Stations, isolated by them from routine examined foods or from foods suspected to be the cause of food-poisoning. All of these strains were coagulase-positive.

The enterotoxins C, D and E and related anti-sera were kindly supplied by Professor M. S. Bergdoll (Food Research Institute, Wisconsin, USA) or purchased from Serva\* (Germany). The enterotoxins A and B and related antisera were prepared by Burbianka and Pliszka [2, 3] in our laboratory.

The enterotoxigenicity of the investigated strains was tested by the slide-gel double-diffusion test of Crowle [2], that is a very simple and specific method for the detection of enterotoxin.

The *S. aureus* strains were cultivated on cellophane, according to the method described by Burbianka [53].

## RESULTS AND DISCUSSION

Out of the 289 *S. aureus* strains under investigation, 105 (36,5%) produced enterotoxins.

\* The specimens purchased from Serva appeared to be weaker than the others and the choice of the dilutions of enterotoxins and antisera adequate to the gel immunodiffusion test was very difficult.

Among the strains isolated from foods suspected to be the cause of food poisoning 68,8% were enterotoxigenic. This means that in our investigations, the percentage of enterotoxigenic strains appeared to be lower than in the related study of Casman et al. [5] or Simkovicova and Gilbert [9] and similar to the percentage found by Burbianka (1971): 63.7% and Toshach and Thornstein [10]: 44%.

Only 2 strains produced enterotoxin E. Each of them has been isolated from a separate incident of food poisoning: one from ice-cream, the other — from sausage.

The enterotoxin D alone was produced by 12 strains. 20 strains produced enterotoxin D in association with enterotoxin A, 2 strains — with enterotoxin C and 4 strains with enterotoxins A and C.

Out of 212 strains isolated from various foods during routine examinations — 24,5% appeared to be enterotoxigenic.

The results are presented on Table.

Table. Enterotoxins production by *Staphylococcus aureus* strains isolated from various foods

| Origin of the strains         | Number of strains | Number of enterotoxigenic strains |   |    |    |   |    |    |    |    |     | Number of strain failed to produce enterotoxins |     |
|-------------------------------|-------------------|-----------------------------------|---|----|----|---|----|----|----|----|-----|---|-----|
|                               |                   | A                                 | B | C  | D  | E | AB | AC | AD | CD | ABC |   | ACD |
| Food suspected of being toxic | 77                | 20                                | 3 | 6  | 7  | 2 | 0  | 0  | 11 | 0  | 1   | 3   | 24  |
| Milk and dairy products       | 32                | 5                                 | 0 | 0  | 1  | 0 | 1  | 1  | 7  | 1  | 0   | 0   | 16  |
| Meat products and poultry     | 22                | 0                                 | 0 | 3  | 0  | 0 | 1  | 3  | 0  | 1  | 0   | 0   | 14  |
| Ready-to-serve foods          | 21                | 6                                 | 0 | 2  | 1  | 0 | 0  | 0  | 1  | 0  | 0   | 0   | 11  |
| Other foods                   | 137               | 9                                 | 1 | 2  | 3  | 0 | 1  | 1  | 1  | 0  | 0   | 1   | 118 |
| Total                         | 289               | 40                                | 4 | 13 | 12 | 2 | 3  | 5  | 20 | 2  | 1   | 4   | 183 |

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## WYSTĘPOWANIE W ŻYWNOSCI GRONKOWCÓW WYTWARZAJĄCYCH ENTEROTOKSYNY, ZWŁASZCZA E I D

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### Streszczenie

Zbadano wytwarzanie enterotoksyn przez 289 szczepów gronkowców wyizolowanych z różnych produktów żywnościowych. Z żywności, która spowodowała zatrucia pokarmowe z 77 szczepów, 53 wytwarzały enterotoksyny, z czego 7 szczepów enterotoksynę D, 11 — A i D, 3 — równocześnie A, C i D. Tylko 2 szczepy produkowały enterotoksynę E. Z 32 szczepów pochodzących z mleka i produktów mleczarskich 15 było enterotoksycznych. Enterotoksynę D wytwarzał 1 szczep a A i D — 7 szczepów. Z 21 szczepów wyizolowanych z wyrobów garmażeryjnych — 10 produkowało enterotoksyny, w tym 1 szczep D i 1 — A i D.

Z innych środków spożywczych na zbadanych 137 szczepów 19 było enterotoksycznych. Enterotoksynę D wytwarzały 3 szczepy A i D 1 — szczep oraz równocześnie A, C i D — 1 szczep.

Stwierdzenie w 2 różnych ogniskach zatruc pokarmowych szczepów produkujących enterotoksynę E sugeruje, że może ona mieć znaczenie epidemiologiczne, chociaż szczepy produkujące ją spotyka się rzadziej, aniżeli szczepy wytwarzające pozostałe enterotoksyny: A, B, C i D. Szczepy wytwarzające enterotoksyny D lub A i D związane są głównie z żywnością podejrzaną o wywołanie zatrucia pokarmowego.