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DEPARTMENT OF THE ARMY
Fort Detrick
Frederick, Maryland

#284

Staphylococcal Enterotoxin.

by A. I. Stolmakova - of the Chair of General Hygiene (Chief - Prof. V. Z. Martynyuk) of the Lvov Medical Institute.

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At present not a single opinion exists concerning the nature of staphylococcal enterotoxin.

While determining the thermal stability of the staphylococcal enterotoxin and the hemolytic properties of the staphylococci in relation to their ability to produce enterotoxin, we received data permitting a discussion of the nature of the staphylococcal enterotoxin.

We were investigating the resistance to thermal processing of the staphylococcal enterotoxin (in artificial nutritive media and in some food products) of 2 strains of staphylococci which were isolated in a food intoxication.

The standard method for taking the enterotoxic filtrates was used.

The test tubes with the filtrates of the staphylococcal cultures, containing 6 - 10 - 15 ml of the enterotoxin, were placed into boiling water in wide-necked flasks and heated for periods of 10, 20, 30 minutes, 1, 1½ and 2 hours. The temperature within the filtrate reached 96-98° C.

The presence of the enterotoxin in the filtrates was ascertained on kittens cats and puppies. The kittens and puppies took the filtrate orally; the filtrate was injected intravenously into the grown cats and some of the puppies. The control animals were given unheated enterotoxic filtrates of the staphylococcal cultures and the heated and unheated nutritive medium which we used in producing the enterotoxin.

The tests showed that the filtrates containing the enterotoxin, which were heated for periods of 10,20,30 minutes, and also for 1 and 1½ hours in a boiling water bath, produced intoxication both in the kittens and puppies, where they were given per os, and in the cats and puppies into which they were injected intravenously. The decrease of the enterotoxin's activity is connected with the duration of the heating. Complete destruction of the enterotoxin did not occur, even when the heating continued 2 hours. (table 1).

Food products, containing an enterotoxin, and water extracts from them were also subjected to the thermal processing in the boiling water bath for periods of 1, 1½ and 2 hours.

The results of the tests (table 2) show that the staphylococcal enterotoxin in milk, cereal mush and mashed potatoes, is not destroyed with a 1½-hour heat processing. In the 2-hour processing, the enterotoxin is, it seems, destroyed to a significant degree and produces an experimental intoxication only in individual animals.

We attempted to ascertain whether all the filtrates of the staphylococcal cultures exhibiting an enterotoxic activity, contain hemo-toxin. In all 104 strains of staphylococci which generate enterotoxin were checked for the presence of hemotoxin by the standard method of titration with rabbit erythrocytes.

Of the 62 strains of staphylococci which were isolated from the mucous membrane of the mouth and nose, 47 showed a hemolytic activity. With this, 15 strains had a hemolytic titer of 1:50, 27 strains had from 1:50 to 1:1,000 and 4 had from 1:1,000 and higher. Hemotoxin was not detected in 15 strains. Consequently, although a significant portion of the strains of the staphylococci, possessing the capacity to produce enterotoxin, simultaneously produce also a hemotoxin, there exists enterotoxic strains of staphylococci which do not produce hemotoxin.

With an investigation of the hemolytic function of strains of staphylococci, which were isolated in food intoxications, it was also established that not all of the strains which produce enterotoxin simultaneously produce hemotoxin. Thus, of the 42 strains which form enterotoxin, 8 strains did not produce hemotoxin.

Consequently, out of 104 strains of staphylococci which form enterotoxin, 23 did not possess the capacity to produce hemotoxin.

It seemed of interest to ascertain whether the strains of staphylococci possessing a high hemolytic titer cause intoxication of animals. We checked the capability to produce enterotoxin in 17 strains of staphylococci which generate hemotoxins having high titers (over 1:1,000). Only 11 of them proved to be enterotoxic.

Thus, it is proper to consider that staphylococci can generate enterotoxin without simultaneously producing hemotoxin.

Conclusions

1. That enterotoxin is not destroyed when subjected to 96-98° over a period of 1½ hours attests to its definite thermal stability.

2. Enterotoxin can be produced separately from the hemolysin. Obviously the staphylococci possess an heterogeneous toxin. The staphylococcal filtrates may contain various substances, of which one is enterotoxic.

3. Food intoxications, evidently, can be caused by staphylococci that do not produce hemotoxin.

Table 1

The staphylococcal enterotoxin's degree of thermal stability.

Duration of the heat processing	No of animals given the enterotoxin	The no. of animals in which intoxication occurred.
10 minutes	5	5
20 minutes	7	7
30 minutes	17	17
1 hour	26	24
1½ hour	12	10
2 hours	10	2

Table 2

The enterotoxin's degree of thermal stability in the food products.

Duration of the heat processing.	Name of the product.	No. of animals in which the intoxication occurred.	No. of animals given the enterotoxin.
1 hour	milk	4	4
1½ hour	milk	5	4
2 hours	milk	12	1
1 hour	cereal	2	2
1½ hour	cereal	5	5
2 hours	cereal	6	-
1 hour	potatoes, mashed	2	2
1½ hour	potatoes, mashed	6	5
2 hours	potatoes, mashed	7	2