Need for Methods for the Bacteriological Examination of Crustacea*

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IN recent years the commercial production of cooked crustecea meats, packed in unsealed containers and shipped under refrigeration ready for consumption, has attained an important place among the seafoods industries. While statistics are not available to show over a period of years the actual production of fresh crabmeat handled and shipped as a perishable commodity, it is estimated from the known catch of hard crabs that the approximate pack in the Chesapeake Bay region alone increased from 2,000,000 lb. in 1925 to 5,200,000 lb. in 1931.[1] In that year the production of fresh crabmeat in the United States amounting to 6,779,990 lb., represented about 75 per cent of the total production of all crustacea meats sold in packages as "fresh-cooked."

Fresh crabmeat is produced commercially in 10 states on the Atlantic and Gulf Coasts and in the 3 Pacific Coast states, and in Alaska. It has become a well known article of diet and is in demand for salads, cocktails, soups, and certain cooked dishes. In addition to crabmeat other crustacea meats are produced commercially and are shipped in cooked condition ready for consumption. In the United States and Alaska in 1931 there were produced in a fresh-cooked condition 124,052 lb. of lobster meat, 1,671,455 lb. of cooked and peeled shrimp, and an appreciable, but unknown, quantity of crayfish, or spiny lobster meat,[2] making a grand total of all cooked crustacea meats, including crabmeat, of nearly 9 million lb. This is no insignificant item in the American dietary.

In order to understand why there is any particular need for the development of bacteriological methods for the examination of these products it is only necessary to consider the methods of production, the opportunities for contamination, and the perishable character of the products. In preparing this type of food for the market the crustacea are cooked in retorts or open kettles. Then, after cooling and trimming, the meat is picked out by hand. Grading is based on the part of the body from which the meat is taken, and according to size of the lumps or flakes. After picking and before packing the meat may or may not be washed. The product is then weighed into cans and with no further heat treatment is packed in larger containers with crushed ice for shipment.

Special investigations with crabmeat

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have shown that the meat within the shell of the crab after cooking is sterile or nearly so. From the cooker on to the final container the product is subjected to multiple sources of contamination. Cooling of the crabs, lobsters, or crayfish, may be conducted under conditions which grossly contaminate the exterior of the shells. During picking this contamination may be transferred to the meat. Pickers too frequently are not scrupulously clean in their habits. Pans, knives, work benches, and utensils with which the meats come in contact may not be maintained in clean condition. The products also come in contact with water and ice, frequently of unknown sanitary quality. In some sections where crustacea meats are produced in quantity, toilet facilities and methods of waste disposal are primitive and crude. In some establishments it has been observed that adequate provision is not made to protect the meat from contamination with material from filthy and dangerous sources. Unless constant warfare is waged to prevent it, contamination may occur from flies, rats, and mice. Crab, lobster, and crayfish meats are handled extensively from the time of cooking until the product reaches the consumer, and there is ever present the opportunity for contamination with filth and with pathogenic bacteria. It is not the intention to imply that all crustacea meats, as produced commercially, are unclean or potentially dangerous. It is regrettable that observations in some communities have too often disclosed objectionable conditions and faulty methods, but in such instances vigorous action has been taken to bring about the desired reformation. With the proper sanitary control it is possible and practicable to produce crustacea meats free from objectionable bacteria. Following recent reforms in sanitary procedures we have reason to believe that crustacea meats as now produced commercially are clean and wholesome. There is, however, need for constant bacteriological control.

It is not unreasonable to compare crustacea meats with oysters or clams that are eaten raw. In fact, the comparison might be extended to include milk. All these products offer conditions conducive to the growth of bacteria. All are handled extensively during production and are subject to contamination with pathogenic organisms, and, to some extent they are all consumed in the condition as produced without further cooking. It has been recognized for a long time that in the interest of public health and consumer protection, control or oyster, clam, and milk production involving bacteriological examination has been necessary. Standard methods for the bacteriological examination of milk and oysters have been in existence for a number of years. There is also a need for the development of a bacteriological method to ascertain whether or not fresh-cooked crustacea meats have been produced under sanitary conditions and are fit for consumption.

In its regulatory work in connection with the enforcement of the Federal Food and Drugs Act, the Food and Drug Administration in recent years has accepted the presence of fecal *B. coli* in cooked crabmeat and other cooked crustacea as evidence of filth and potential danger to health. Certain experimental work and extensive experience with these products have demonstrated a correlation between insanitary methods of production and the incidence of fecal *B. coli* in the finished product.

Institution of regulatory control of commerce in crustacea meats was begun

in an attempt to prevent the recurrence of food poisoning cases which had from time to time been reported as due to crabmeat, and to prohibit the distribution of unclean products. There were no methods for bacteriological examination of these products described in the literature. The need for such methods called for an adaptation to crustacea meat of recognized procedures for the detection of *B. coli* in other products. For some time there has been employed in the Food and Drug Administration a method of crustacea meat examination which has been satisfactory. A known amount of meat is weighed aseptically in a wide-mouth sterile bottle. To the meat is added a known amount of sterile water or salt solution, and the mixture is shaken vigorously with sterile glass beads. The resulting suspension then consists of washings of the meat containing the bacteria present on the product. Standard lactose broth is inoculated with decimal dilutions of this suspension and incubated at 37° C. Where positive presumptive tests are obtained the lactose broth cultures are streaked on plates poured with Levine's eosin-methylene blue agar. From the eosin-methylene blue agar plates typical fecal *B. coli* colonies, when present, are transferred to agar slant cultures and are later further identified and classified as to their position in the colon-aerogenes group.

This method has worked satisfactorily in the hands of the various analysts of the Food and Drug Administration in the examination of nearly 3,000 individual packages of fresh-cooked crustacea meats. The results obtained have in general correlated with the known sanitary conditions under which the meats were produced. Since the technic and media already mentioned have been found reasonably satisfactory, we have not attempted to substitute other methods or other media which are sometimes used for the detection of *B. coli* in foodstuffs. It is possible that the substitution for standard lactose broth of some other medium might result in a higher percentage of confirmations of fecal *B. coli*. Also some medium might be selected that would restrict the growth of those bacteria which interfere with the growth of colon organisms. Any of several direct plating methods using a differential medium for distinguishing members of the colon-aerogenes group might be applied to expedite the analysis. It is necessary that any method adopted must be productive of prompt results in showing whether or not fecal *B. coli* are present in crustacea meat suspected of being polluted. The product is produced, shipped, and consumed in a short period of time, and any method applicable for control purposes must be reasonably rapid. Whether the adoption of some method different from that outlined here will further expedite the work and produce equally reliable results is a subject for investigation.

It has been stated that the presence of fecal *B. coli* in crustacea meat has been accepted by the Food and Drug Administration as evidence of filth and potential danger to health. In interpreting the results of bacteriological examination of these products it has not been the practice to attach the same significance to non-fecal and intermediate strains of colon-aerogenes organisms. Just what interpretation is to be placed on the presence of members of the colon-aerogenes group not proven to be fecal in origin is an open question. The presence of such organisms may have more significance in these products, which are sterile as they start on their way through the picking house, than they would have in certain raw products. For the time

being, however, we can assume that colon-aerogenes organisms not strictly fecal in character do not indicate potential danger to health in the use of the product, although their presence may represent an undesirable contamination signifying an unclean condition. We do know that in properly conducted establishments crustacea meats can be, and are being, produced entirely free from *B. coli*. It would seem then that the presence of any fecal *B. coli* in fresh-cooked crustacea meat would constitute evidence of improper handling and filth. Standards and tolerances are always controversial topics. We are making no definite recommendation now, but if standard bacteriological methods are to be developed, some thought must be given to the question of permissible numbers of colon-aerogenes organisms, if any at all are to be permitted, in products of this kind.

In the control exerted over crustacea meat products, it has not been the practice to place a great deal of emphasis on total counts of bacteria. Nevertheless, the total counts of aerobic organisms do have a very definite significance. All the viable bacteria on the finished product are the result of contamination picked up in the preparation of the meat for shipment. Consequently, the total numbers of bacteria present are a direct index of the degree of cleanliness and expedition exercised in handling the product. It has been the procedure to plate dilutions of the suspension obtained as heretofore described using standard nutrient agar with incubation at 37° C. Better media and more appropriate incubation temperatures might be devised for these products. Any standard method developed should not overlook the significance of total counts in ascertaining the fitness or unfitness of crustacea meats for food purposes.

With the growth of the industry producing fresh-cooked crustacea meats various control agencies, both official and nonofficial, have a common interest in helping to produce a clean, sound, and wholesome food. Each of these agencies can, of course, develop a method of examination satisfactory to themselves, and can establish their own standards and tolerances. Such a development of diverse methods and standards of judgment would result only in confusion for the producer, and for those control agencies organized for the protection of public health and human welfare. A uniform procedure and a common basis of judgment are needed.

A statement then as to the need for methods for the bacteriological examination of crustacea can be summarized in a few brief sentences. There is an increasing production and a wide distribution of crustacea meats sold in cooked condition ready for consumption. These products are subject to contamination throughout their preparation, distribution, and sale. The nature of the contamination is such that it carries with it potential danger to the health of the consumer. The technical control of preparation and the legal control of production, distribution, and sale involve bacteriological analyses. For the accomplishment of the greatest good there should be one method of analysis acceptable to and used in common by all agencies having a part in the sanitary control of these products.

REFERENCES

1. Crab Meat. *United States Tariff Commission Report to the President*. Report No. 57—Second Series. 1933.

2. *Fishing Gazette*. Annual Review Number, June 15, 1933, p. 72.