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STAPHYLOCOCCUS AUREUS IN MARINE PRODUCTS

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From the public health point of view, an important bacterium to be considered in fishery products is *S. aureus*. The genus *Staphylococcus* belongs to the family Micrococcaceae. Since 1930, it is known that contamination of food with *S. aureus* could cause gastro enteritis of sudden onset because the organism growing in food secretes an exotoxin. This toxin is generally termed as enterotoxin as it affects the intestinal mucosa. Food poisoning caused by *S. aureus* is very common.

Morphology

It is an asporogenous non-motile, Gram-positive Cocci occurring singly, in pairs or in the form of irregular clusters resembling bunches of grapes.

Food poisoning due to *S. aureus*

Staphylococcal food poisoning due to consumption of various fishery products including shrimps canned in brine, smoked cod in oil, sprats in oil, North African sardine in oil, Moroccan sardine in oil, kippers, fish sausage, fish pudding, boiled smoked mackerel, salted herring, frozen fish sticks, fish cakes, tuna and cooked, peeled frozen shrimps have been reported. In many cases, contamination during handling and processing, coupled with favourable time temperature conditions in the factory before processing has been the cause of poisoning. In most cases, where canned fish were incriminated in the food poisoning, the tins were not bulged as *S. aureus* neither formed gaseous products nor did it produce any abnormality in appearance, odour or taste of the product.

Primary habitat

According to the current epidemiological information, the main reservoir of *S. aureus* is man; his hands, face, sweat, boils, ulcers, nasal cavities, throat, ear-gum and post-nasal drips of man contain this organism in large numbers. About 30% of human population is known to be nasal carriers of this organism. Skin of 30% of food handlers are known to inhabit *S. aureus*. Therefore, this organism while being a cause of food poisoning is also a useful indicator of hygiene in a process involving human handling as in the case of shrimp processing.

Toxin production

Presence of a few *Staphylococci* per gram of food material may be harmless. Food poisoning usually happen if the product is handled carelessly during later processing allowing the multiplication of the organism in dangerous proportions. The organism can multiply vigorously and produce toxin at room temperature. Hence, adequate refrigeration of the material during handling and processing is highly essential in preventing further multiplication and toxin production. The toxin, once formed, will not be materially affected at 100°C even though the organism will be killed at this temperature. Therefore, the normal cooking temperature, though sufficient to kill *S. aureus* could leave the toxin unaffected. It is thus evident that, once sufficient quantity of toxin is formed in a food material before its consumption, food poisoning can follow even though the material is cooked. Foods most such asly involved in Staphylococcal food poisoning are cooked and processed foods having small numbers of competing microorganisms. Large number of *S. aureus*(usually more than one million organisms/g of food material) must be present at one time to produce enough enterotoxin and to cause disease symptoms. Less than one microgram of enterotoxin is sufficient to cause illness in a sensitive individual. It is now well established that staphylococcal food poisoning is caused only by certain well defined strains of *S. aureus* and such

strains are found to produce coagulase. These strains are therefore termed as coagulase-positive *Staphylococci*. However, not all coagulase-positive *Staphylococci* are not capable of causing food poisoning. Food-borne outbreaks due to coagulase-negative *Staphylococci* have also been seldom reported.

Staphylococcal food poisoning symptoms are caused by antigenically distinct polypeptides which function as emetic toxins known as enterotoxins. Eight numbers of such enterotoxins designated as A, B, C1, C2, D, E, F and G have been reported. The toxin most commonly implicated in food poisoning is enterotoxin A while those strains which produce enterotoxin B are only rarely found. On the basis of fundamental research work carried out recently, it may be assumed that 80% of *S. aureus* strains of human origin do possess the capacity of forming one or more toxins.

Symptoms

Nausea, vomiting, abdominal pain, diarrhoea, absence of fever and sub-normal blood pressure are the usual symptoms which start within 1 to 6 hours after consuming the infected food. Complete cure is possible within 48 hours.

Incidence in fishery products and processing environments

Fish caught from unpolluted waters does not contain *S. aureus*. However, contamination with this organism takes place during handling of fish by workers engaged for processing. Further, it is also known that *S. aureus* can grow in fish if conditions are suitable. The incidence of the organism has been found to be comparatively higher in cooked and prepared fishery products evidently due to human handling after cooking and the inherent behavour of *S. aureus* to grow competitively in substrates containing minimum number of other micro-organisms. The following observations have been made in the investigations carried out at the Central Institute of Fisheries Technology, Cochin (Table 1.)

Table 1 Incidence of coagulase-positive *Staphylococci* in seafood processing

Sample	Type	Percentage samples showing incidence of coagulase-positive *Staphylococci*
HL shrimps	frozen	6
PD shrimps	frozen	12
PUD shrimps	frozen	14
Cooked shrimps	frozen	38
Raw lobster tails	frozen	24
Cooked lobsters	frozen	17
Cuttlefish	frozen	0
Squids	frozen	17
Frozen	frozen	0
Catfish	frozen	0
Water		1
Ice		3
Utensils		10
Palm of shrimp-handlers		34
Throat of shrimp-handlers		45

Growth rate studies

Studies carried out at CIFT on the growth rate of *S. aureus* at different temperature in shrimp-homogenate indicated that growth of *S. aureus* starts from 6°C onwards. This suggests that shrimps should always be preserved below 6°C. This is particularly important in the case of cooked shrimps where the total bacterial load is generally low and permits rapid multiplication of *S. aureus*.

Viability at sub-zero temperature

Research work carried out at CIFT has indicated that only 5-15% of *S. aureus* inoculated to cooked shrimps were killed during freezing (40°C). There was gradual destruction during frozen storage at -20°C and complete loss of viability within seven months.

Ability of *S. aureus* to grow in competition with other bacteria present in fish

Though a virulent organism capable of producing toxin, *S. aureus* cannot compete with saprophytes and many other bacteria present in fish during phases of active growth. They are outnumbered by many competitors. Results of the experiments carried out in CIFT has clearly indicated that *S. aureus* cannot grow in shrimp-homogenate in competition either with *E. Coli* or *faecal streptococci* at 28°C, 10°C or 0°C. It has also been observed that *S. aureus* is unable to grow along with the natural bacteria flora present in shrimps at any of the three temperature cited above. These results explain why high percentage of *S. aureus* is usually encountered in cooked fishery products. The studies also indicate that *E. Coli*, *faecal Streptococci* and the natural bacteria flora present in fish exert certain control on the growth of *S. aureus*. In the absence of this 'bacterial protection', food poisoning due to *S. aureus* would have been much more than what it is at present.

Maximum permissible limit of *S. aureus* in frozen fishery products.

For most of the fishery products, the maximum permissible limit *S. aureus* is 100/g.

Detection of the organism

A definite weight of the fish sample is homogenized with 9 times its quantity of phosphate buffer. Of this 0.2 ml is streaked on the suface of pre-dried Baird -Parker medium. The black, shiny, convex colonies (1.0 to 1.5mm diameter) with a halo around are regarded as presumptive coagulase-positive *Staphylococci* and these are confirmed by coagulase- test.

Prevention of contamination

Contamination can be prevented by adequate control over the health and hygiene of fish-handlers and adequate refrigeration below 5°C of the material during handling and processing.