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FISH PLANT SANITATION, QUALITY CONTROL & INPLANT INSPECTION

1979

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY
(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)
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Compiled by

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FUNDAMENTAL ASPECTS OF QUALITY CONTROL OF SEAFOODS

CYRIAC MATHEN

Introduction:

The fish eater expects certain characteristics in the fish he buys. How far his requirements can be met with, depends on proper understanding of these characteristics and how best they are retained in the fish till it reaches him. With seafoods, it is comparatively difficult to fully satisfy the consumer's requirements due to lack of control on the raw material before harvest. What at best can be done is to exercise proper quality control from the time fish is taken out of water. Even to do this the basic set up, objective, and responsibilities of quality control department, the different aspects of quality and the national and international regulations must be fairly understood. A brief outline of these aspects are given below:

Quality, Quality Control, Inspection:

Quality means different things to different people. It is commonly thought of as degree of excellence. In general terms, quality is defined as the composite of those characteristics that differentiate individual units of a product and have significance in determining the acceptability of that unit by the buyer. In relation to seafoods, quality embraces intrinsic composition, nutritive value, degree of spoilage, damage, deterioration during processing, storage, distribution, sale and presentation to the consumer, hazards to health, satisfaction on buying and eating, aesthetic considerations, yield and profitability to the producer and the middleman. In short, fish quality means all those attributes which consciously or unconsciously the fish eater or buyer considers should be present.

Quality control is defined as the continuing assessment of a process in operation. Quality control in the case of seafoods means all the steps taken between harvesting and retail trade which protect the quality of the final product.

Inspection consists of the monitoring which is necessary to measure the effectiveness of the quality control procedure and also those official devices which are used to protect the consumer and facilitate trade.

A system of quality control is better than end product inspection, because, in the latter case, the quality of the product is known only after the end product is formed, thereby incurring losses by manufacturing a poor quality product. In quality control procedure, it is possible to reject unsuitable material before it goes to the production line. Unfortunately the present official system we have is only end product inspection. However, compulsory inspection right from harvesting - i.e. quality control, is being contemplated.

Uniqueness of seafood quality control:

Quality control of seafoods differs a lot from that of any other food product. Fruits, vegetables or meat are harvested under ideal conditions i.e. the right type of food is harvested at the right time and at the right place. This means that it is possible even to select the right species, to rear them to the desired level of growth and to harvest them in a pre-determined place as per pre-determined schedule. In the case of seafoods, the harvesting is from the sea, from stocks of unknown identity as to age, sex etc under the most difficult conditions. Hence, the intrinsic quality varies in all possible combinations. In addition, the initial handling, processing and preservation are carried out under highly unfavourable conditions giving room for imperfect operations. Another hurdle in proper quality control of seafoods is the unpredictability of catch. At times, the catches may exceed the handling capacity. A typical example in our fisheries is the 'Chakara' season when even ice may not be sufficiently available. More control will be possible when fishing changes from mere hunting to harvesting. Even with fish, quality control is comparatively easier in certain parts of the world where there is availability of limited number of species of fish in large quantities. However, it is not so with tropical fisheries, where large number of species are harvested in limited quantities making quality control more difficult. However, with advancement in aquaculture it may be possible to select the species, rear them to the desired size and harvest them as and when required.

Set up, objectives and responsibility of quality control department:

Quality control work is the duty of an individual or department directly responsible to the management. Whether it should be an individual or department depends on the size of the producing factory. A small unit can entrust the responsibility to an individual whereas in larger units a group of individuals may be needed. The quality control department should be in close touch with the production and marketing divisions. The latter should be able to furnish changes in outlook on quality and quality complaints and the former should be willing to incorporate new suggestions from the quality control organisation.

The objectives of quality control are : reduction of rejects, maintenance of uniform quality, increased customer satisfaction and employee morale and minimising costs. The usefulness of a quality control organisation is usually felt only when an avoidable quality defect is rectified thereby improving profit to the organisation. Otherwise, the existence of such a department is taken for granted.

A proper quality control set up can result in maintenance of uniform quality in products. Study of the factors affecting quality and the stages of production will be important. Quality is assumed to be allright when there are no consumer complaints; that is to say when there is customer satisfaction. Further, employees should be always educated and alerted on quality aspects so that it is a way of life with them to produce the best. All this may be possible where production cost is not considered. Too much cost of production results in high prices at sales point and potential customers may look for substitutes resulting in reduced sales. Hence proper quality control should consider cost aspect too. Quality improvement at minimum cost is the one required.

The responsibilities of a quality control department are the following:

1. Formulation of specifications for raw materials, supplies, inplant process, containers and finished products including shelf life.
2. Development of test procedures and testing of quality levels and production variables
3. Development of sampling schedule - number of units and frequency of sampling to be worked out
4. Preparation of forms for recording and reporting and quality control charts
5. Attending to troubles and advising stoppage of production or rectification of defects
6. Attending to special problems regarding quality and complaints
7. Training of personnel

Fish processing units which have an organised quality control set up are very few in our country. This is largely due to the small size of units processing seafoods. In many cases the responsibility of purchase, processing, packaging, quality control and marketing rest on one and the same individual.

This system, though has certain advantages especially in decision making, its disadvantages overweigh. First of all, one may not be a master of all the different aspects encountered. Secondly, the time that can be reasonably be allotted to each task becomes very little. Provided the size of opera-tion is very small this system is found to work more economically than satisfactorily. In the present set-up of our industry the quality controller/ department shall be responsible for (1) decisions relating to the quality of raw material purchased (2) specifying the processes to be followed (3) general maintenance of sanitary conditions including general cleanliness of plant premises, cleaning schedules, quality of water and ice, workers' hygiene, etc (4) specification for packaging materials and method of packaging (5) end product testing and preshipment inspection.

Different aspects of seafood quality:

Based on origin of the quality factors, quality is broadly grouped as intrinsic and extrinsic. Intrinsic quality is inherent in the material and relates to species, size, sex, condition and composition, parasites, poisonous fishes, contamin-ation with pollutants and occassional peculiarities. Extrinsic quality is the sum of the effects of all the treatments fish receive after catch till they reach the consumer. It is obvious that intrinsic quality is beyond direct control while extrinsic quality can be properly controlled.

Certain fishes are generally costly because they are rated as 'good quality' fishes for example seer fish and pomfret in our country. Here quality is related to species. Hence species identification assumes importance where the external features of the fish are destroyed while processing as is frozen fillets or minced meat.

It is general knowledge that large specimens of a given species fetch better price. Prawns, crabs, lobsters etc are typical examples. Processors place higher value on large specimens because of higher percentage yield of edible material, lower handling costs per unit weight, better keeping qualities and yielding of more uniform products. For certain purposes, say for example canning, the biggest size is not the optimum a-s in the case of prawns because of difficulties in controlling fill weights. Control of size is to some extent exercised by choosing the fishing grounds, seasons or methods. Manual or mechanical sorting is also possible after catch.

Preference of fish based on sex is known to exist but there no documentary evidence of this w-here as our fish species are concerned. The females of certain species are more valued probably for the roe.

In certain seasons fish is said to be in good 'condition' and at other times in poor 'condition'. Condition here refers to the biochemical and physiological state. Fish in poor condition is known to have more w ater content and less fat content. This is usually so after spawning. Sardines and mackerels are known to show wide variation in their fat content depending on season. Sardines in October, November and December have very high fat content and are preferred by many during this season. Feedy fish are known to be prone to belly bursting and hence they cannot be kept for long. Glycogen content in certain shell fishes vary with season. When glycogen is lower, the amount of la-ctic acid formed is also lower and hence the pH higher. This means that such fish will be subject to microbial attack earlier. Crabs are known to differ in meat content dependent on full moon - new moon periods. A special problem in certain fishes is 'chalkiness' i.e. the fish flesh becomes more white during storage and texture becomes poor. This occurs in seer fish during certain seasons and is related to the more acidic pH attained. Considering many of these points, regulations exist in some nations on fishing seasons.

Incidence of parasites in fish is another quality factor. These parasites are unsightly and can cause difficulties when discovered by the consumer. Only few of these parasites are harmful. Many of these parasites are located in the head, viscera etc which are not eaten. Parasites are a health problem where fish is eaten raw. Some parasites are seen in our tuna as also in froglegs. Some common parasites in seafoods are protozoa, flat worms, round worms, certain crustacea, fungi and bacteria. Protozoal infection may cause softening of flesh. e.g. Chloromyscium thyrsites. Many flat worms are free living but flukes and tapeworms are parasites. Two diseases in man are caused by ea-ting the cysts of two types of flat worms - the lung fluke (paragonimus) and the broad tapeworm (Diphyllobothrium latum). Round worms or nematodes may be found in the flesh. The cod worm, (porrocaecum decipiens) is a well known example. The occurrence of crustacea, fungi and bacteria is not a major problem in processing.

Some fishes are naturally toxic. Quality control personnel should be able to identify such species. Poisoning due to fishes are ciguatera, Puffer and paralytic shell fish poisoning. Ciguatera poisoning occurs by eating certain species of fish at certain seasons certain species of fish usually taken from shallow waters in or near tropical and subtropical coral reefs. It is rarely fatal. Cooking does not destroy the poison. Puffer fish poisoning is by eating the puffer fish flesh contaminated with viscera. Mortality rate is 50% and largest incidence is in Japan. Paralytic shell fish poisoning is by eating certain molluses and in particular, mussels and clams. The toxicity is related to the occ-urrence of dinoflagelates in the harvesting water. When these organisms are too much the water assumes a reddish tinge. The only protective measure is not to collect shell fishes from such waters.

Contamination of fish with pollutants is another problem which an ordinary fish eater is unable to identify. Toxic elements like mercury, cadmium, lead, selenium and arsenic; organic chemicals (pesticides) like D.D.T., aldrin, dieldrin, benzene hexachloride, and polychlorinated biphenyls, radioactive isotopes and micro-organisms are also contaminants. Limits have been specified for these contaminants by national as well as international quality control organisations.

Peculiarities like tumour, ulcers, nodules, abnormal colouration, abnormals odours etc are also rarely noted in fish. Of course they do not pose a serious problem in processing.

Among the extrinsic quality factors, degree of freshness, conformity to the declared mode of presentation, weight, size, ingredients and food additives, acceptability of the processing methods and suitability of containers and packaging methods are important. Special significance is attached to the sanitary conditions under which the products are handled and processed as evidenced by the degree of contamination with pathogenic and faecal indicator organisms.

National agencies in seafood quality control and inspection:

The Indian Standards Institution is the national agency which brings out standard specifications for fish, fishery products and processing conditions. These standard specifications are formulated after consultation with the traders, manufacturers research institutes and all other organisations interested in seafoods. More than thirty five standards are available at present. The Central Institute of Fisheries Technology, Cochin, through its Quality Control Section, has been rendering advice on quality to the processors since its inception. The Institute was mainly responsible for the implementation of Compulsory Preshipment Inspection at present being carried out by the Export Inspection Agency. All export consignments are to be accompanied by a certificate of fitness for export.

International organisation in seafood quality control:

Codex Alimentarius Commission of FAO and WHO of the UN has a separate committee on fish and fishery products to formulate standards for important products in international trade and also to work out codes of practice, where applicable. A few standards like that for canned prawns, canned pacific salmon, quick frozen fillets of salmon, cod and haddock, and ocean perch, canned tuna etc have been formulated. More are in the different stages of formulation.

Summary:

Though quality control of seafoods is a difficult proposition, recent trend is to implement it on some scale, the degree of perfectness depending on the market requirements of the product. In addition to the trade itself, national and international organisations have been formed with the purpose of promoting seafood quality control. It is to be expected that more and more emphasis will be laid on quality control in the coming years, the stress possibly being for additives - both intentional and unintentional.

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GENERAL PRINCIPLES OF FISH PRESERVATION

M.K.KANDORAN

Introduction:

The world food situation requires continuing effort to increase and preserve the food materials, particularly protein foods from animal sources because of their value in up-grading the nutritional quality of the diet. The food materials get spoiled on storage and the types of spoilage depends on the composition, structure, type of micro-organisms involved and the conditions of storage. The prindipal causes of spoilage in foods are the growth of micro-organisms, the action of naturally occurring enzymes in the foods, chemical reaction and physical degradation and desiccation. The basic purpose of all food preservation is to prevent the above types of spoilage and make the food available at some future time or at distant locations.

There are several methods of preservation of foods. This article refers to the fundamental principles involved in different methods of food preservation with special emphasis on freezing and canning.

FREEZING

Freezing means removal of heat from a body. Heat is a form of energy transferred by conduction, convection and radiation. The preservation of biological material by freezing depends upon the inhibitary effect of low temperature upon the rate of growth of microbial organisms and the enzymatic and biochemical reactions which normally occur in unfrozen foods. Storage temperature below 6.6°C is required to prevent the microbial spoilage of food. Unfortunately, storage at such temperature has some adverse effect on many biological materials. The production of ice is responsible directly or indirectly for nearly all the undesirable side effects of low temperature storage. The mechanisms by which freezing injures biological materials are

1. mechanical rupture of the structural components through the growth of ice crystals,
2. mechanical rupture of cells by growing ice crystals, releasing enzymes and substrates,
3. the effect of dehydration as liquid water is precipitated as ice which may cause (a)precipitation of proteins and other macromolecules from solutions and (b) changes in pH.

Changes during freezing:

The physical changes which occur during freezing fish comprises, formation of ice with expansion of volume and desiccation starting from the surface of the frozen fish with the consequent damage of muscle cells and concentration of minerals damaging the proteins and irreversibly altering them. During freezing, protein-water gel is completely altered because the water separates out as pure ice, leaving the proteins more or less dry. Freezing increases toughness which proceeds progressively during subsequent storage.

Formation of ice is initiated when the temperature of fish is lowered to about -1°C. At the same time, a concentration of various inorganic salts andorganic compounds occurs. Consequently, freezing point falls. At -3°C, about 70% of the water is frozen. At -5°C about 85% is frozen, at -25°C about 95% and at -50°C to -60°C almost all the water in fish is frozen. Thus the larger part of water is frozen between -1° and -5°C and it is the rate of cooling during this temperature interval which determines the size of the ice crystals. Ice formation first occurs at the heat extracting surface, and subsequently proceeds in the direction of the warmer mass while conducting heat from the warmer area to the refrigerating medium.

Slow freezing forms big crystals rupturing the tissues more. Quick freezing forms small crystals. Large crystals in the case of slow freezing are able to penetrate the cell walls resulting in larger drip when the fish thaws.

Drip formation:

Excessive amounts of drip reflects degradation in the quality of frozen products. If the drip is discarded, water soluble nutrients and flavour are lost. Food that exudes a large amount of drip is usually dry and woody or tough in texture. A large amount of drip adversely affects the appearance of the product and causes a shrinkage or loss of weight. Accordingly the amount of drip is often measured and used as one of the criteria for judging quality of frozen products.

Quick freezing:

Quick freezing means generally that the temperature of every part of the product falls below the zone of 0° to -5°C as rapidly as possible and within a certain limit. There must be rapid rate of heat flow relative to a given temperature.

So the problem is the speeding up of heat flow by reducing the resistance offered to heat exchange. For fish, this maximum time is given as two hours for the lowest region, that is the centre of a package of fillets or the centre of the thickest fleshy part of a whole fish. Freezing is complete only when the equilibrium temperature reaches -18°C. The product temperature is maintained at -18°C or colder during storage and transport with a minimum temperature variation. The advantages of quick freezing are the following:-

1. Ice crystals formed are smaller
2. As the freezing time is shorter, less time is allowed for the diffusion of salts and evaporation of water
3. Decomposition is prevented during freezing

Quick freezing can be effected in three ways:- (1)direct immersion of food in the refrigerating medium. (2)indirect contact with the refrigerant, as by conduction through plates, (3)forced convection of refrigerated air directed at heat transfer surfaces.

General Methods of Freezing:

Freezing is effected by the following:

Sharp freezer:- Sharp freezer is a room which can be maintained at a low temperature usually -18°C or lower. This type of freezer takes considerable time for freezing food (air is a poor conductor of heat). This is slow freezing.

Air blast freezer:- This differs from sharp freezer in that it is usually designed in the form of a tunnel and takes full advantage of the heat - transfer effectiveness of rapidly circulating air. The temperature used in air blast freezing ranges from 0 to -30°C. A-ir velocity varies from 30 to 1050 metres/mt.

Contact plate freezer:- Here, the food, either packed or unpacked, is placed between metal plates and the heat extracted by direct conduction to the plates through which is circulated the refrigerant.

Vertical plate freezer:- This freezer employs refrigerator plates to provide a series of vertical compartments or "cans" into which the food is loaded for freezing.

Immersion freezing:- In this method, the packed food is immersed in a low temperature liquid which absorbs heat from it.

The advantage of immersion freezing is that there is perfect contact with the refrigerating medium and therefore heat transfer is high. But there are some disadvantages also for this method of freezing such as: (i) the temperature has to be controlled carefully, (ii) it is very difficult to keep the medium from dirt and contamination, (iii) the refrigerating medium must be edible and capable of remaining unfrozen at -18°C and slightly below. Solutions of sugars, glycerol and sodium chloride are the ones usually employed.

Liquid freon freezing:- In this case the food is either immersed in or sprayed by liquid freon.

Liquid nitrogen freezing:- This affords the faster practical method of freezing and hence ensures the maximum possible preservation of initial qualities of food. The very low temperature and high refrigeration capacity of liquid nitrogen, together with its inert characteristics which permit intimate contact with food, makes possible freezing rates many time faster than that which can be achieved using existing techniques.

Fluidized bed freezer:- In a fludized /freezer the /bed product to be frozen is individually suspended in the upward flowing cold air stream of the freezing tunnels and hence the best possible heat transfer is achieved between the air and the product. In this method every fish is frozen individually and very quickly a-nd there is no distortion of their shape by pressure. The freezing time for shrimp and similar small varieties is only a few minutes according to the size.

Cryogenic freezing:

This name is applied for the freezing method where food is either immersed or sprayed by very low temperature liquids such as nitrogen, air etc.

Sub-freezing:

The application of negative temperature near -2°C ± 1°C is an advanced approach in the field of refrigerating technology. The subfrozen fish has been found to keep its water holding capacity which favours the quality of products.

CANNING

Canning may be defined as heat processing of food in a hermetically sealed container in order to reduce the effect of bacterial contamination to a commercially safe level. For all practical purposes, it may be considered that fresh foods normally carry organisms which will cause spoilage if not restricted in their activity. The basis of canning process rests on the destruction of these organisms by heat and prevention of the entrance of others. The organoleptic and nutritive properties of the product are also retained to the greatest possible extent by canning.

Canning method:

The basic method of canning operation consis-ts of the following steps:

1. Preparation of raw materials,
2. Precooking/blanching,
3. Filling,
4. Exhausting,
5. Sealing,
6. Processing,
7. Cooling,
8. Labelling, casing and storing

Preparation of raw materials:

Quality of any processed food depends on the quality of raw material. Therefore great care should be taken in selecting absolutely fresh fish for canning.

Once the raw material is received in good bacteriological condition, the general policy is to operate either under a cold or a hot schedule and avoid leaving the material at medium temperature for any length of time.

Pre-cooking/blanching:

This is a process by which the raw food is heat treated before or after filling in cans but prior to sealing. The material is immersed in hot water/brine or exposed to live steam with or without pressure depending on the type of the material and pack.

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Pre-cooking/blanching serves a number of purposes. One of the objectives is to shrink the raw product to permit adequate filling in the can. This step also expels respiratory gases from the cellular tissues which will increase vacuum in the final product. It cleans the raw material and reduces bacterial contamination. The process inhibits enzymatic action and retards browning of some products. The extent of pre-cooking/blanching is determined by the characteristics of the individual food products.

Filling:

Filling of correct weight of material has an important bearing in the canning process. For example, the efficiency of exhausting procedure is, in part, dependent on the amount of free space above the surface of the fish in the can, while the ratio of solid to liquid material markedly influences the rate of heat penetration into the container which affects the processing treatment.

Exhausting:

Exhausting is to remove air and gas from the can. This procedure is necessary for the following reasons.

1. Minimisation of strain on the can through expansion of air during heat processing.
2. Removal of oxygen which accelerates internal corrosion of the can.
3. Creation of a vaccum when the can is cooled. Cans with bulging ends are regarded as unsound. It is necessary to ensure that the can ends remain flat or slightly concave throughout m-oderate storage temperature.
4. Oxidation of fat and consequent deterioration is prevented.
5. Vitamin C is preserved.

Vacuum is the condition where the pressure in a system is reduced from the atmospheric pressure. It is one of the indications of sound packing procedure. It reduces the strain on the container during processing, thereby preventing the buckling of the ends.

Biologically, a vacuum is important in that it restricts the growth of organisms requiring air for growth. Chemically, it is important to remove the oxygen from the air in the head space of containers. Vacuum in containers of fish helps protect colour and flavour of products, assists in retaining vitamins, prevents rancidity due to oxidation, helps retard the corrosion of the plate and the corrosion of the closures of the glass containers. Physically, vacuum is of value in holding the closures on glass jars, keeping the ends concave in cans and reducing the pressure within containers while being heat treated.

Sealing:

The objective of this process is to obtain air tight seal between the cover and the body of the container so that spoilage agents cannot enter the sealed container after the canned fish has been sterilised.

Processing:

Objective of this step is to apply heat to the container and its contents at a temperature and for a length of time sufficient to kill or inactivate potential spoilage agents without overcooking the fish. This process is the most important step in the canning operation.

Processing time and temperature required for each food depends on.

1. the type and number of spoilage agents in or on the product.
2. the consistency of the product. Solid pack and thick liquids require larger periods of processing.
3. the acidity of the products. Most spoilage agents are less resistant to heat in the presence of acids and usually, the more the acid in the product, the less is the processing required.

The complete elimination of air from the retort is a vitally important factor in steam processing. Air reduces the retort temperature. Air being heavier than steam, tends to form a layer below the steam. A mixture of air and steam at any temperature is not as efficient as saturated steam at the same temperature. From these considera-tions it will be clear that

sole reliance in processing should not be placed on pressure-guage reading alone, there must be agreement betw-een the readings of both pressure guage and thermometer, the accuracy of which is of course important and should be checked periodically.

Cooling:

The objective of this process is the rapid removal of heat from the canned fish after processing to prevent overcooking. Also, rapid cooling of the canned fish tends to inhibit the growth of any spoilage agent that may not have been killed by the heat processing. The cans should be cooled to a temperature of 35°C and this will result in their retaining sufficient heat to ensure rapid drying of the can surface and thus protecting against rusting. Chlorinated water (5 ppm) can be used for cooling purpose.

Labelling, casing and storing:

Every label must bear the name of the product, net contents and other specific information as required. The object of storing is to hold the canned fish under conditions that do not alter the quality of the fish or the appearance, of the container. The processed cans must not be cased hot, because the loss of heat by radiation from the cases is slow and this will cause injury to quality.

In order to keep chemical change to a minimum, temperature of storage room for foods should be held just above the freezing point of the canned products. Glass packed foods should be protected from light. Light catalysed reactions include bleaching of colour, destruction of vitamins and flavour deterioration.

Spoilage of Canned Products:

The chief causes of spoilage are the following:

1. under processing, 2. inadequate cooling, 3. infection resulting from leakage through seams, 4. pre-process spoilage.

Under-processing:

Any pack which suffers spoilage as a result of the activities of organisms surviving the heating process can be termed underprocessed. In under processed packs the activity of the surviving organisms may result in gas production which causes the can to become a "swell" or the contents may undergo acidification or some other undesirable change affecting quality, but gas is not produced. When growth of micro-organisms occurs without gas production, the affected cans have a normal appearance externally and spoilage is only detectable after can has been opened.

Inadequate cooling:

Some bacteria (thermophiles) multiply rapidly in a high range of temperature and failure to cool cans immediately after processing to a temperature of about 35°C may lead to serious spoilage.

Leakage through seams:

The micro-organisms infecting canned fish as the result of post-process leakage of the containers may be of widely varying types. The main source of the organisms is the cooling water.

Pre-process spoilage:

Spoilage of this type is an example of faulty canning pradtice whereby bacterial development in the fish is permitted during the preparation period. Processing may subsequently sterilise the pack, but the liberation of gas produced by the organisms during the lag period before processing may cause swelling or flipping of the cans.

Seaming:

In ideal seaming the edges of the cover and the body are properly folded to form five folds of metal. In improper seaming the cover hook is compressed against the folded body hook creating an opening betw-een the body and the cover for a portion of the perimeter through which spoilage agents enter the can.

DRYING

Drying is a process by which water from a moist substance is removed. If air is used to carry away the water vapour formed, the process is called air drying. This can be "natural drying" (exposed to outdoors to the effect of sun and wind) or "artificial drying" (inside a dryer).

To be efficient the outdoor drying requires a dry atmosphere, sunlight and also a slight breeze. Under unfavourable atmospheric conditions artificial drying is advantageous. Artificial drying allows the process to be continuous (day and night) and permits the standardised production of a product of high and uniform quality.

During the initial stages of drying the surface of fish muscle behaves like a saturated surface. During this period the rate of evaporation is uniform and is maximum. This stage of drying is known as the "constant-rate period". In practice, the constant-rate period is terminated when the rate of diffusion of water from the interior of the muscle cannot maintain a sufficient flow to the surface to sustain the initial maximum rate of evaporation. The termination of constant rate period is followed by a rapid decline in the drying rate. The rate of drying continues to decrease and becomes negligibly small as the water content of the fish muscle approaches an equilibrium value. This period is known as "falling-rate period".

In the drying process of fish, the constant-rate period is very short whereas the falling-rate period lasts much longer. These two periods are critical because the surface layer of the fish is still moist, therefore perishable and susceptible to bacterial decomposition. To avoid this, drying operation during these two periods should be conducted at the highest possible rate.

The influence of air temperature in drying is considerable. Even a small increase of only a few degrees may appreciably improve the over-all efficiency of the operation. The danger of cooking the fish is most pronounced and can be eliminated only by keeping the temperature below the tolerance limits of fish. The relative humidity of the drying air is also important. It regulates the drying rate and greatly influences the appearance of the final product. The drier the air, the higher the drying rate. The effect of air velocity is more or less similar to the effect of relative

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humidity. Good velocities also favour the distribution of the drying air circulating over the fish and increase the coefficient of heat transfer between the air and the fish.

SMOKING

Smoking or smoke curing of fish is a method of preservation effected by a combination of drying and deposition of smoke constituents. When fish is smoked it is subjected to four basic treatments viz. brining, drying, smoking and heat treatment.

This type of preservation is effected either by "hot smoking" or "cold smoking". During hot smoking the temperature of smoke may rise, at times, to above 100°C while the flesh reaches 60°C and gets cooked. The heat treatment also results in partial sterilization, although subsequent reinfection and spoilage of the cooked flesh is still quite rapid. During cold smoking the temperature is not more than about 30°C and the fish is not even partially cooked.

Formaldehyde, acids and phenols are the important constituents of smoke involved in smoke curing of fish. Among these, phenolic constituents are supposed to be the most effective in preserving fish.

SALTING

Salting is a method of preservation based on the penetration of salt into the tissues and governed by the various physical and chemical factors such as diffusion, osmosis and a series of chemical and biochemical processes associated with changes in various constituents of fish. Salting starts the moment fish surface comes into contact with salt. The end of the salting process is the moment when the entire fish have reached the required salinity and acquired the appropriate taste, consistency and odor.

There are three basic methods used in the salting of fish. They are (1)dry salting, (2)wet salting and (3)mixed salting. Dry salting is characterised by the fish being salted with dry salt. A solution of salt is formed in the water extracted from the fish. The salt as a result of its hygroscopic ability and osmosis absorbs water from the fish

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and is then dissolved by it. Wet salting is a process by which the fish is put into a previously prepared solution of salt. The basic deficiency of wet salting is a rapid decrease in the original concentration of salt brine in the preservation process. Mixed salting is the method by which the fish is salted simultaneously with salt and with brine. In this method the salt on the surface of the fish prevents the brine from becoming diluted. Thus the salt brine remains saturated.

The salting as such amounts to a process of salt penetration into the fish flesh. This period ends when the salt concentration of the fish tissue becomes equal to the concentration of salt in the surrounding solution. The method of salting has a great influence on the structural and mechanical features of the muscle tissue of the fish and considerable changes in shape may result.

In salting of fish it is important to take into consideration the following factors: (1)purity of salt, (2)amount of salt, (3)duration of salting and (4)weather conditions. To reduce the accessibility of oxygen, fish must be completely covered by the brine.

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PRESENT PROBLEMS IN MAINTENANCE OF QUALITY OF SEAFOODS IN INDIA

CYRIAC MATHEN

Introduction:

For convenience of discussion our seafood products can broadly be divided into two - products in export trade and those in domestic trade. Quality of the product whether for export or for domestic market has to be good. It shall be reasonably fresh and shall be safe for consumption. Prawns, lobsters, froglegs, cuttlefish and crab are frozen and or canned for export to sophisticated international markets. Of late there has been some export of frozen fishes like pomfrets and seerfish and canned sardines. Dried fish are exported to neighbouring countries like Srilanka. Our domestic consumption of seafoods includes mainly fresh fish and cured and dried products. Of course some quantity of canned fish and pickled products is also marketed.

The problems in maintenance of quality in the above two broad groups of products are many and varied. Since its inception in early 50's there has been gradual improvement in the quality of export products especially those which are frozen or canned. There has been improvement in the quality of products in domestic trade too especially because of the development in transportation facilities.

Some of the most common problems encountered are detailed below:

Poor quality raw materials:

A major portion of the industrial raw material is harvested by country crafts and small mechanised vessels. These fishing crafts are of limited capacity with respect to the range of operation in the sea and facilities for holding the catch. Many of these carry out fishing trips of a day or less in duration. As fishing is still hunting from these crafts, and catch is erratic, proper handling and preservation on-board is not perfect always. The country crafts do not have any special fish hold whereas the small fishing vessels have uninsulated fish holds. The catch is stored in boxes or baskets though the latter container is not advisable. There is also the problem of the by-catch. If the fish is to be preserved, the only means on such vessels is icing. Ice has to be carried in separate ice boxes to prevent melting. Many a time it happens that the catch is scarcity and the

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ice is wasted or the catch is heavy and icing is not sufficient. Insufficient icing or no icing will land fish at the boarder line of quality, for a mechanised boat may land the catch within six hours of the first hauling. This is a problem that needs attention from the fishermen. The only solution to the problem is to carry sufficient ice on all fishing trips considering the maximum catch. Financial losses due to loss of ice may occur, but saving in quality of the landed catch may outweigh the losses. It is also worth considering subsidised prices for ice.

Deterioration in quality is not a serious problem in raw materials caught by country crafts or those available from paddy fields. In the former case the time lapse between catch/ the interval between first collection of the catch and icing may be maximum three hours.

On larger vessels which can remain in the sea for a week or more and land the catch iced, the problems are more complicated. It is accepted that prawns can remain in a fair condition upto seven days in ice. The usual defect noted in raw prawns landed by such vessels is mainly black-spots. Details of this phenomenan are given separately. It is also essential to segregate each day's catch on board and to keep them so till taken for processing.

Once the material is landed iced or uniced, further deterioration can be carefully controlled as workers are more relaxed on land. Under usual rates of landing, prawns do not remain for long at the landing site pending auction. Between landing and arrival at the primary process centre the main quality deterioration is by admixture with sand and also physical damage.

Perhaps one of the important factors that contribute to deterioration in quality of raw material is the 'double stage' processing-i.e., distribution of processing between the peeling sheds and the freezing or canning factory. The peeling sheds are many and scattered all along the coast. Many of them are substandard in design and construction and lack primary facilities like potable water supply. A still worse set up is the so called 'hut peeling' process wherein the raw material is distributed to the peeling hands who do the peeling work at home. This set-up has been found to contribute much to contamination of the meat with sand and micro-organisms. Even salmonella has been isolated from material procured from such sources. It is a set up which under all circumstances should be dropped. It is to be noted that in the case of a delicate food item like shrimp, / and landing may be three hours or less in the latter case

socialism in the production and processing side can never go hand in hand with good quality. Attention is needed in the primary process centre especially to see that (1) the sand adhering to the whole prawns are washed off before starting any processing. (2) the heading operation is done in such a way that unsightly appearance does not result. (3) the peeling and deveining operations are complete (4) broken pieces are separately kept.

Raw materials, after primary processing are packed with ice in metallic containers with perforated bottom and transported to the processing factory. It has been noted in many cases that on receipt in the processing factory the ice at the sides of the container is melted exposing the prawns to the metal and thus to higher temperature. Thus care has to be exercised while packing to see that sufficient quantities of ice are put at the bottom, sides, intervening layers of prawns and at the top. At all times the temperature shall be at or below 5°C.

On receipt at the processing factory, the material shall be checked for quality, especially discolouration, deterioration, size grade, foreign material etc. The semi-processed material is either taken for further processing or stored.

Blackspots in shell or shrimp:

Blackspot formation or 'melanosis of shell on prawns is a major problem in the prawn freezing industry. It is established that it is an enzymatic reaction and requires access to oxygen in addition to the presence of certain heavy metals like copper or iron. Melanosis, though has nothing to do with eating quality, mars the appearance. A batch of prawns heavily affected with melanosis cannot be packed as headless prawns but may be packed as peeled meat thus diminishing the unit value. Prevention of melanosis demands cutting of access to oxygen. In the usual practice keeping the material in ice and water with a layer of the same above the material prevents black spot formation. The enzyme is more concentrated in the head portion. Hence removal of the head portion immediately after catch and washing of the tails followed by icing delays the phenomenon. Prawns that has remained for long without ice at ambient temperature when iced develops blackspots much earlier than a sample iced immediately after catch. This points to the significance of icing immediately after catch. Intensity of melanosis is species specific. Kazhanthan is the most succeptible followed by Naran, poovalan and karikkadi. Chemicals like potassium metabisulfite in small quantities used as a dip delays the onset of melanosis. A 0.2 - 0.5% solution either in fresh water or in seawater can be used with a dipping time of 1-2 minutes. However, it is better to establish the doses under

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working conditions before starting large scale treatment. It is also to be noted that higher levels of sulfite cause bleaching of the shell colour. An interesting phenomenon observed in the industry is that in one case when the prawns were transported (iced) in a refrigerated van the black spot development was very high, while when the refrigerator system was put off melanosis was less. The only explanation that could be offered was the effect of the continuous blow of air in the refrigerated van.

Weight loss during thawing:

On thawing frozen seafoods loose some weight, as thaw drip. Thaw drip usually consists of water containing soluble nutrients and flavour bearing components. Weight loss due to thaw drip is to be compensated by addition of excess weight at the time of freezing. The extent of weight loss due to thaw drip depends on the type of seafood. The loss from frozen HL prawns is 5%, that from frozen shrimp meat is 10-15%, and from cooked frozen prawns 7-10%. In froglegs thaw drip loss is 5-10%. Even in prawns the extent of loss is related to size; the bigger the size the smaller the loss and visa-versa. Species differences also affect weight loss. Thaw drip losses from thelly meat and karikkadi meat are the highest. Thaw drip losses increase with pre-freezing ice storage period. Thaw drip losses are prevented by treatment with phosphates. However, the present food laws of the country does not allow use of phosphates. Hence, control of weight losses requires careful manipulations during draining, weighing, freezing and frozen storage.

Dehydration in frozen products:

Dehydration is evident as white patches on the frozen tissue. Proper packaging with exclusion of air pockets from the package, sufficient glazing, maintenance of constant, storage temperature and relative humidity are important. Since in many cases the storage period of frozen products in the cold store does not exceed a few weeks to two months, dehydration or freezer-burn is not a major problem of the industry.

Bacterial defects in frozen prawns:

Frozen prawns, in addition to possessing good organoleptic characteristics, have to befree from excessive numbers of bacteria. It is also required that some types of bacteria like E.coli, and coagulase positive staphylococci shall be present only in very low numbers and salmonella shall not be present.

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Food standards are generally strict about bacterial quality of precooked products. Precautions and sanitary practices like chlorination of water supplies both for use in processing and ice manufacture, application of regular cleaning schedules, workers' hygiene etc are very important to keep down bacterial contamination. The system of "hut peeling" contributes too much towards poor bacterial quality of frozen shrimp meat. It may be noted that shrimps have been rejected for presence of salmonella. 'Hutpeeling Centres' and froglegs might have contributed to contamination of frozen prawns with salmonella. Problems of high E.Coli contamination have been encountered both in cooked frozen prawns and frozen froglegs. They have been overcome.

Blue/Black discolouration in canned shrimp and crabmeat:

Shrimps canned in brine are known to develop blue/black discolouration at the head portion of the meat. This has been shown to be due to the formation of copper and/or iron sulphides. Copper and iron are present in very small quantities, in the shrimp tissue and from the sulphur content in the protein H_2S is formed during processing. Blackening occurs when the concentration of Cu and/or iron exceeds certain critical levels. Copper and Iron are taken up by the muscle during processing from contact surfaces, water, ice, salt, citric acid etc. Discolouration due to Cu and/or Fe Sulphides can be prevented by adjusting the titrable acidity in the fill brine and also by addition of EDTA disodium salt in the fill brine at the rate of 50 mg%. Very fresh prawns require only lower quantities of citric acid to adjust the titrable acidity to 0.06%. whereas raw material stored in ice require more acid. Crabs too contain higher levels of Copper. Blueing can be prevented by either proper bleeding at the time of butchering or by addition of EDTA salt.

Underweight in canned shrimps:

Irrespective of the moisture content in the blanched prawns, canned prawns have moisture dontent of 72%. This is called the equilibrium moisture level. To get correct drained weight prawns are to be blanched to the equilibrium moisture content. If the moisture level were higher i.e. the material is underblanched the canned product will show underweight. It is always essential to standardise blanching conditions and to follow it strictly. Particular attention is required to keep up the concentration of salt and citric acid in the blanching brine as also the time of blanching to obtain correct drained weights.

Bacterial problems in canned products:

All canned products are to be commercially sterile. Commercial sterility means that though some bacteria may be present in the can they may not be able to multiply and spoil the contents of the can under the environmental conditions available in the can. Sterility - commercial or absolute-is tested after incubation of the cans at 37°/56°C for 14/4 days and examining for growth in certain nutrient media. As a whole 3% of canned prawns are shown to be not commercially sterile. Bacterial problem may be due to (i) insufficient sterilization and (ii)post process contamination from cooling water. It is essential to see that the processing time and temperature are kept up correctly. It is to be noted that a certain time at a certain temperature may not hold good for sterilisation, when the bacterial load has gone up due to contamination or spoilage. Hence, the processing line need be kept up in clean condition and there should not be any hold up. Post process contamination usually occurs from cooling water. Cooling water shall be of sound bacterial quality and shall contain free available chlorine. Contamination can take place through faulty seams as also through normal seams. Seams, though normal, can always allow sucking in of water at the time of cooling because of the strain due to temperature differences. The preventive step for faulty seam is checking of seam after every 200 cans.

Excessive water content in oil packs:

Fish canned in oil shall not contain more than 10% water in the drained liquor. More water in the fill medium is a defective quality factor as it amounts to cheating the consumer and lowering the shelf life considerably by corroding the can and causing deterioration of the contents. The remedy lies in properprecooking and draining of the cook drip.

Blueing/blackening and browning in frozen lobster tails:

As is in the case of prawns black spot development occurs in lobster tails. It is also noted that at the cut ends black discolouration occurs for the lining of the meat. Thise can be prevented by keeping the lobsters alive upto the time of processing. Brown discolouration develops during frozen storage at the cut end meat portions probably by reactions of the enzyme. Proper glazing, wrapping and low temperature storage are remedial measures.

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Salmonella in frozen froglegs:

Salmonella infestation of Indian frozen froglegs was reported in late 1973 by U.S. FDA resulting in large scale rejections. Salmonella organisms are harboured by frogs especially in the intestines, skin and cloacal area. A method of processing starting with live frogs has been recommended. The salient features of the method are purposeful avoidance of spurting the intestinal contents, removal of cloaca with saddle and use of high doses of chlorine during processing (It is dealt with in the chapter relating to pathogens).

Discolouration in squids and cuttlefish:

Frozen squids and cuttlefish are recent additions to the list of export products. One of the serious problems in this infant industry isyellow discolouration of the tubes and fillets. A little care on board can prevent this. Removal of the appendages, ink sac and gut contents, followed by washing and bleeding immediately after catch prevents yellowing. The semi-dressed material has to be stored in ice and water.

Foreign materials:

There has been several complaints from the foreign buyers of our shrimp that the material contained flies, fibre pieces, bits of papers and excessive sand. More care at the packing time and exclusion of flies in the processing hall is called for, occurrence of sand is mainly a problem with thelly meat and that too mainly peeled by the hut peelers. The avoidance of peeling on floor, pond water for washing especially in summer months, stoppage of hut-peeling and proper washing of whole prawns can help a long way ad-in reducing sand admixture. This is also encountered in canned prawns, reasons being the same.

Poor quality packaging materials:

The packaging material shall be able to withstand the stress and strain of transportation and storage under cold conditions. Proper sizes of the duplex as well as master cartons are very important. Five ply CFD master cases waxed on both sides may be used to pack frozen seafoods.

Pink and dun in cured products:

Salted and dried products develop discolourations as yellow patches which later on cause porous structure of the product.

Thise can be prevented by dusting the dried product at the time of packaging with a mixture of 3 parts of sodium propionate and 97 parts of sodium chloride at the rate of 10% by weight.

Excessive numbers of in-edible materials like veins, shell pices, antinae etc. in prawns:

The presence of these materials though not harmful is unsightly and causes annoyance to the consumer. Proper sorting and washing are the duly remedial measures. This defect can more be a matter of negligence on the part of processors.

Non-conformity to size and labelling:

As there is always loss of drip and subsequently loss of weight, differences in size grade can occur to the extent of the percentage weight loss. Attention is called for in properly size grading before packaging and for leaving sufficient safety margin. Another similar defect is the presence of too large and too small pieces. Labelling regulations are to be strictly followed to avoid difficulties in the importing countries.

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FUNDAMENTALS OF BACTERIOLOGY OF FISH AND SHELL FISH

K.MAHADEVA IYER

Introduction:

Bacteria are single-celled micro-organisms widely distributed in nature. They are found in all environmental conditions. They are present in the intestinal tracts and body surface of animals, soil, and the natural waters like ponds, lakes, rivers and the sea. There are both useful and harmful or disease-producing bacteria. Many bring about such useful changes as the decomposition of dead tissues of plants and animals while some of the disease-causing types or pathogenic bacteria cause various types of illness in man, animals and plants. Almost all the animal and vegetable foods are decomposed by bacteria if the foods are not preserved properly.

Morphology:

Bacteria are single-called organisms seen only through microscope. They occur in any of the three fundamental shapes.

Shape:

1. Spherical
2. Rods
3. Spiral or curved rod.

Size:

The size ranges from 0.5 μ to 100 μ in length, the common range is 1 to 3 μ for the rod form and 0.5 μ for the diameter of the spherical bacteria (one μ = Micron = $\frac{1}{1000}$ th of a millimeter)

Reproduction:

Under favourable conditions a single cell of bacterium multiplies by breaking apart into two. This method of multiplication is called binary fission.

Flagella:

Some bacteria show hair-like appendages on their body. They are called flagella (flagellum-singular) They usually confer 'motility' (ie capacity to move) in bacteria especially in a liquid medium. Usually rod-shaped bacteria possess flagella. The number of flagella varies from one to many.

Spore-formation:

Some bacteria form spores to resist unfavourable conditions like heat, cold, dryness etc. These are produced from the normal vegetative cells which undergo modification to form spores. Usually some of the rod shaped bacteria produce such spores. When favourable conditions return the spore 'germinate' to form the original vegetative cells.

Gram-stain:

One of the methods of classifying bacteria is to find out whether they are gram positive or gram-negative. If after gram-staining, bacteria take up a violet colour, the organisms are said to be gram-positive and if red, the organisms are said to be gram-negative.

Method of Gram-staining: A thin bacterial film on a glass slide is covered with a solution of crystal violet for a fixed time (1 mt) The stain is washed off with water. Then a dilute solution of iodine is added over the film and allowed to remain for the same period of time. After this, the slide is washed with rectified spirit until no more colour comes from the film. Finally a counter stain like Safranine (red) is poured over the film and allowed to remain for $\frac{1}{2}$ mt. The slide is then washed with water and allowed to dry.

Some organisms retain the violet stain even after washing with alcohol so that the red counter stain is not taken up by the film. Such organisms appear violet and are termed gram-positive.

Others do not retain the primary stain (ie) Crystal violet during the washing of the film by rectified spirit. They take up the counter-stain (Safranine) and appear red. They are gram-negative.

In addition to above, there are organisms which are weakly gram positive or gram-variable.

Conditions of bacterial growth:

Growth of bacteria is influenced by the environmental conditions and availability of nutrients for growth.

Effect of temperature:

Bacterial growth takes place within a wide range of temperature, say from 0°C to 90°C. On the basis of temperature requirement for growth, bacteria can be classified into

a) Psychrophiles
b) Mesophiles
c) Thermophiles

Psychrophiles as the name itself indicates are cold-loving bacteria. They thrive well at low temperatures say between 0°C to 20°C with an optimum growth temperature at about 15°C. Some of them cause spoilage of foods at low temperature.

Meso-philes are those which grow near about the atmospheric temperature, say between 20°C-45°C with an optimum of 37°C. The disease-causing bacteria or pathogens come under this group.

Thermophiles - are those which require higher temperature for growth (between 45°C-90°C) with an optimum temp. of 55°C. Some of the bacteria occurring in natural hot springs can thrive at a temp. of 85-90°C.

Effect of pH:

pH is a measure of acidity or alkalinity of a medium and is expressed as a number. pH 7 indicates a neutral medium. Eg. water which is neither acidic nor alkaline. Whereas Acids like hydrochloric acid, sulphuric acid in solution are strongly acidic and their pH may be less than 7 and in [illegible] and for alkaline ranges, the pH values are above 7.

For growth of bacteria, the optimum pH of the growth medium is usually 7.2. Only special types of bacteria and fungi require pH which is either on the acidic side or on the alkaline side.

Bacteriology of fish:

General:

Fishes as caught from any waters contain microflora, the nature of which depends on the microbial types and contents of the waters from which the fishes are caught. Fishes are caught from the open sea, backwaters, fresh water lakes and rivers, each containing its own types of bacteria which influence the microbiological quality and spoilage of the fish caught from the respective waters.

Bacteriology of natural waters:

Sea:

Sea water contains varied types of microflora. These bacteria are not free-swimmers, but are usually found in association with planktons and other marine flora and fauna. Far out in the sea, the flora are more or less typically marine. But near shore and at harbour mouths, the waters contain varying proportion of terrestrial bacteria. One characteristic of marine bacteria is that they are able to tolerate a higher concentration of sodium chloride than the terrestinal bacteria.

Backwater:

These are generally areas of intermingling of fresh and saline waters. The salinity of these waters is not constant as in open sea, but fluctuates with season, tidal influx etc. These waters also contain varying proportion of fresh water bacteria as well as bacteria of marine origin.

Fresh water lakes and rivers:

They also contain bacteria, their principal characteristics is their low tolerance to sodium chloride. But these bodies of water, especially if they happen to be near human habitation, are subjected to faecal contamination which introduce pathogenic bacteria into the waters. Consequently fishes caught from these waters are likely to be contaminated by these bacteria also.

Occurrence of bacteria or fish:

A freely swimming fish in the sea harbours bacteria mainly at three sites 1.the surface slime 2.the gills and 3.guts especially in a feedy fish. The muscle or flesh or other internal organs like liver, heart etc. of a healthy fish are sterile.

As long the fish is alive, the activity of these bacteria is under check and they can not act on fish muscle. But once the fish is dead, these bacteria start attacking the flesh, thereby initiating the pheno menon of microbial spoilage.

Bacteria load on fish:

This means the number of bacteria per gram of fish muscle or per unit area of the fish surface.

For e.g., in ocean-fresh sardines, the figures are as follows:

On the skin & muscle	-	10^3 to 10^5/g
At gills	-	10^5 to 10^6/g
In guts	-	10^5 - 10^8/g

In general the magnitude of bacterial load is guts > gills > skin and muscle.

Types of genera of bacteria or fish:

One important characteristic of the microflora of ocean-fresh fish is that more than 90% or sometimes 100% of the microflora consists of gram-negative rods. Only a very low percentage of gram-positive organisms is present in ocean-fresh fish.

But once the fish is landed on the boat-deck, or taken to wharfs, factories etc. the proportion of gram positive organisms increases depending on the extent of terrestrial contamination. A typical generic distribution of bacteria on skin and muscle and guts of fresh sardines is given below:

Bacterial genus	Percentage in skin & muscle	Guts
Achromobacter	32	30
Vibrio	27	15
Pseudomonas	14	30
Flavobacterium & Cytophaga	11	2
Corynebacterium	7	1
Micrococci	6	1
Bacillus spp.	1	0
Aeromonas	1	3
Photobacterium	1	18

In the case of prawns, the bacterial load is a little higher than in fish. They are also susceptible to bacterial spoilage much faster than fishes.

Microbial spoilage of fish and methods of prevention:

One of the striking similarities between man and the microbes is that their food requirements are much the same. The most nourishing of human foods are almost always ideal foods for bacteria. That is the reason why milk, egg, meat and fish spoil so rapidly once they have been contaminated by bacteria in sufficient numbers. What we often call spoilage is, in essence, nothing more than a partial digestion of food by myriads of these little organisms. During this digestion varying amounts of volatile and non-volatile compounds are liberated from the foods. More often these possess bad odours which indicate that the spoiling phenomenon has set in. Volatile amines and organo-sulphurous compounds are examples of such compounds.

Methods of preservation:

ICING

The simplest method of preventing spoilage of fish and prawns is icing. By mixing with sufficient quantity of ice, the temperature of the fish is brought down. Once the temperature is brought down, the activity of these bacteria is reduced and the onset of spoilage delayed. Normally under tropical conditions fish kept at ordinary temperature will start spoil after 6 to 7 hrs and become unfit for human consumption. But iced properly, fish can be kept in prime condition for a few days say 4 to 6 days. After this period, in spite of the fish being kept in ice, the spoilage starts because of the increase in the number and activities of cold-loving bacteria (psychrophiles) which thrive at low temperatures. This method of keeping the fish fresh is mainly intended for short-term storage of fresh fish not exceeding 5 to 6 days.

FREEZING

For longer storage of fresh fish, another method is freezing wherein the temperature of the fish is brought down to sub-zero temperatures of -20°C to -40°C in freezing machines and then storing the frozen fish at sub-zero temperatures (-20°C). This method reduces the bacterial content of the fish by 60 to 90%. Freezing causes death to some of the bacteria or considerable reduction in their viability. At sub-zero temperatures, the activities of the surviving bacteria comes to a stand-still and hence the fish keeps well for longer periods, say a few months under frozen conditions.

HEATING

By the application of heat also, the bacterial content in a food can be reduced. This is achieved in canning of fish and fishery products. The aim here is to achieve more or less complete destruction of bacteria by enclosing the fish or fishery product in a metal can of suitable size alongwith a sus-pending fluid, usually brine or oil and then heating the cans under stipulated temperature in special vessels. The processed product is almost free from bacteria and hence keeps well for months at a stretch.

Pasteurisation is another process which is effected either by heat or high energy irradiation. Here also a partial destruction of bacteria in foods is effected. This reduction in number of bacteria slows down the development of spoilage flora and delays spoilage if not prevents it altogether.

USE OF CHEMICALS

Other well-known methods to control the bacterial proliferation in fishery products is the use of certain chemicals like sodium chloride coupled with dehydration. This method is employed in the preparation of cured fishery products. The high salt content in the product keeps down the bacterial multiplication and the product is thus given a considerably longer shelf-life.

In general, partial inhibition processes are most effective when applied very soon after the death of the fish. Once the spoilage flora has entered into a stage of vigorous growth, such processes are of little value.

Microbial hazards in fish and fishery products:

The natural microbial flora found on fish or shell fish as caught from natural waters away from land masses consists of bacteria which are harmless to human beings. But subsequent handling of fish after catch is likely to contaminate it with varying kinds of bacteria of terrestrial origin including those which are pathogenic to humans. The chances of contamination with such harmful bacteria are high unless a high degree of sanitation is maintained from the moment of catch till it reaches the consumer. The pathogenic bacteria which are likely to contaminate the fish are Coliforms, Escherichia coli, faecal streptococci, Salmonella, Staphylococci, Clostridia etc. All these groups of bacteria are of human origin except perhaps the Clostridia whose natural habitat is soil. The occurrence of the first three groups of bacteria on fish or processed fishery products indicates faecal contamination and is a pointer for the likely presence of Salmonella which is a greater pathogen and hence must be totally absent from any fishery product. While the occurrence of a certain minimum number of Coliforms, Escherichia Coli, or Streptococci and Staphylococci is allowed in fish and fishery products, presence of even a single cell of Salmonella makes the fish unfit for human consumption. Salmonella are known to produce enteric fevers and diarrhea when they infect the human system through food. These organisms generally do not grow at $0^{\circ}C$ and at refrigeration temperatures but above such temperatures they are likely to grow in foods under favourable conditions and infection ensures by consuming such contaminated foods. The chance occurrence of Salmonella organisms in fish meal is likely to cause Salmonella infection in poultry when infected fish meal is fed to chickens. Fortunately Salmonella are heat-sensitive and the heating of fish meal to about $60^{\circ}C$ under standard conditions eliminate this hazard and makes it safe for poultry feeding.

While Salmonella causes infective type of food poisoning, the case of Clostridia is different. They produce a powerful toxin which is lethal for human beings. These organisms grow in environments where oxygen is absent or present only in trace amounts. Canned prawns and fish are prone to develop this type of poisoning if the processing parameters happen to fall below standards resulting in

under-sterilization of cans. It has been observed that meat foods including fish stored at room temperature or under slight refrigeration may also become dangerous rapidly due to growth of this organisms but will remain safe for a considerable length of time at less than 10°C. Clostridium botulinum may sometimes develop and produce toxin in frozen foods which have been allowed to thaw and then stored at temperatures 10°C or higher. However, frozen foods, if properly handled and kept frozen until use, are probably as safe as fresh foods.

Food poisoning caused by Staphylococcus is probably milder in effect. These organisms are carried in throats of human beings and found in great numbers in the nasal discharge following common cold and in wounds. Obviously workers with nasal infection or recurrent cold should be excluded from handling of fishery products in processing factories. The organisms do not produce toxin at temperatures of 4 to 6°C of storage. Above this temperature, toxin is produced under favourable conditions which is likely to cause food poisoning.

In general, a high degree of sanitation is to be maintained, from the moment the fish is caught till it reaches the consumers' table. The use of good quality ice for preserving raw fish, the periodical cleaning of boat decks, fish boxes, fish holds, efficient cleaning of table taps, utensils in processing factories with good detergent and subsequent washing with chlorinated water and above all maintenance of good personal hygiene among factory personnel will go a long way in the improvement of the bacteriological quality of sea foods and make them more wholesome and safe for human consumption.

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PATHOGENS AND FAECAL INDICATOR ORGANISMS IN FISH AND FISHERY PRODUCTS

T.S.GOPALAKRISHNA IYER

Introduction:

Flesh of fish in the live condition is free from bacteria, but bacteria will be present in the gills on the skin and in the intestine. So long as the fish is in the live condition, those bacteria cannot do any harm to the fish muscle. When the fish is dead bacteria present both inside and outside will act upon the muscle converting the fish protein to many simpler products simultaneously producing many off smolling metabolites. Now we say that the fish is spoiled and it is no more edible. Determination of total bacteria count therefore gives an idea about the extent to which spoilage has proceeded. But it should be remembered that even the freshest raw material handled and processed immediately after catch may turn dangerous to human health if handled under unhygienic conditions, thereby allowing the entry and multiplication of certain genera of bacteria generally known as pathogens (disease producing organisms). Hence, adequate laboratory tests to detect, isolate and identify such pathogens are also done in the routine quality control procedures before the consignment is certified as fit for human consumption.

At first sight it may appear that presence of micro-organisms are not very much significant in fish as they will get destroyed during cooking in the kitchen. But this notion is far from the truth for the following reasons.

1) Potential loss of organoleptic and nutritive quality.
2) The risk of the food rapidly becoming unwholesome in presence of excessive bacteria.
3) Production of heat stable toxins by some bacteria (Staphylococcus aureus)
4) Production of rancid odours in fatty fishes by Pseudomonas fragi and Mycobacterium phlei.
5) Conversion of histidine (an amino acid) to histamine (a poisonous substance) by organisms belonging to the species Proteus morgani.
6) Cross contamination in refrigerated storages.
7) Esthetics: It is generally accepted that the consumer has the right to be protected against unwarranted contamination in foods.

Primary sources of bacteria to foods:

a) Soil and water: They are the primary source of bacteria contaminating foods. The following genera of bacteria that are generally found in soils and waters may be expected in foods. Achromobacter, Aerobacter, Bacillus, Clostridium, Corynebacterium, Micrococcus, Proteus, Pseudomonas, Serratia and Sarcina.

b) Plants and plant products: Many of the organisms listed above for soil and water are also found on plants since soil and water constitute the primary source of micro-organisms to plants. On the other hand there are some bacteria that are associated more with plants than with soil. These are Erwinia, Kurthia, Lactobacillus, Flavobacterium, Paracolobactrum, Leuconostoc and Streptococcus.

c) Food Contact Surfaces: The genera of bacteria found on utensils depends upon the type of foods handled and the care taken to clean these utensils. Utensils not cleaned and disinfected properly may turn to be an important source of bacterial contamination to foods.

d) Intestinal tract of man and animals: Among these are Bacterioides, Escherichia, Proteus, Salmonella, Shigella, Staphylococcus, Clostridia, Pseudomonas, Peracolabectrum, and Streptococcus. The most notable of these is the genus Escherichia which has its natural habitat in the intestinal tract of man and other mammals. From the intestinal tract of animals, these organisms find their way directly to the soil and water. From soil and water these bacteria find entry to the processing plants and finally to the product.

e) Food handlers: Bacteria are found on the hands and outer garments of food handlers. This flora naturally consists of organisms found on any object handled by the individual as well as those picked up by dust, soil, water and the like. In addition, there are several genera of bacteria that are generally associated with hands nasal cavities and mouth. Among these are the genera Streptococcus Staphylococcus, Sarcina and Gaffkya, the most notable of which is Staphylococcus which is found on hands, in nasal cavities, the mouth and other parts of body. While the genera salmonella and shigella are basically intestinal forms they may be deposited on foods and utensils by food handlers if sanitary precautions are not followed.

f) Air and dust: About 25 genera of bacteria are found in air and dust. Although Staphylococcus and Salmonella may at times be found in air and dust this is not the usual source of these organisms to the foods. Notable among the bacterial genera in air and dust are Bacillus, Sarcina and Micrococcus spp. all of which are able to endure dryness to varying degrees.

Sanitary significance of faecal indicator organisms:

At one time when the detection and enumeration of pathogenic organisms like Salmonella and Shigella was a difficult task, the use of the so called faecal indicator organisms/like E.coli and faecal strep-tococci was the only possible method of assessing the sanitary conditions of processed foods. The underlying principle was that if the indicator organisms are absent, it is possible that the pathogenic types may also be absent. The indicator organisms originally suggested by Scardinger (1892) for this purpose was E.coli first isolated by Escherich (1887) from the intestinal content of human beings and later on supported by many workers by isolating the same organisms from human and animal faeces in considerable proportions. Another organisms which is also universally approved as an indicator organisms is faecal streptococci which is also present in the stools of man and many warm blooded animals.

But now that there are many quick and reliable methods for the direct determination of these pathogenic organisms the question naturally arises whether these indicator organisms have any important role in modern hygiene. The answer must be in the affirmative for the following reasons.

1. First Salmonella as a rule is so heterogeneously distributed in foods and that a negative outcome of its detection has only limited significance.

2. Secondly apart from the classical pathogens of the genera Salmonella and Shigella other organisms may also be spread through foods and many of these especially the viruses and intestinal worms, can be detected only with rather complicated methods beyond the scope of many food laboratories.

3. Thirdly, the absence of enteric pathogens in a representative sample of food has significance only for the consignment under investigation. Repeated failure to isolate the organism is potentially valuable as foods prepared in the same way can over be dangerously contaminated.

4. Finally, the detection of Salmonella in presence of an overwhelming majority of other bacteria present in the food is difficult.

5. These arguments clearly indicate that indicator organisms have still a place in protecting our food supply. But questions are often raised to distinguish faecal contamination from human faeces from those of animals, because these organisms are also present in the animal and bird excreta. But from the hygienic point of view all sorts of faecal contamination are equally dangerous whether originated from man or animals. Perhaps the estimated per capita output of these organisms/24 hr period is more from animal faeces than from human faeces. There is also authentic proof to the effect that pigs and birds are more frequent carriers of salmonella than is man. All these arguments focus to the point that all sorts of faecal indicator bacteria in food are equally objectionable irrespective of their source.

Factors judging the suitability of these indicator organisms in fish:

E.coli: It is a gram negative rod shaped nonspore forming bacteria. Its presence in food is generally accepted as an indicator of faecal contamination in foods. The primary habitat of E.coli is the intestinal tract of many warm blooded animals. Natural water gets contaminated with E.coli either by direct contact or by mixing up with terrestrial sewage. When this water is used for fish processing, these organisms get entry into the product. Similar possibilities arise when the ice used for preservation or the utensils used for processing are contaminated with E.coli. Possibility of a direct contamination of food with faeces is rather remote and if at all happens it does not often exceed 25 mg of faecal matter/10 kg of food which in turn give rise to 100 Enterobacteriaceae, 10 group D Streptococci and a few Clostridia/g of food.

But whatever may be the type of contamination, when once the organisms have entered into a food product in considerable numbers it is very difficult to get rid of them completely. Even if the organisms are completely removed by some chemical treatment, the wholesomeness of the food cannot be guaranteed as many of the viruses and intestinal worms which are comparatively resistant to such treatments will be present in the product in viable forms. Hence it is better to process the material hygienically than to remove the contaminated bacteria in the final stage of processing.

Offshore water generally does not contain E.coli whereas incidence of this organisms is usually noted in near shore waters. Fishing in these waters or washing boat deck and fish containers using near shore waters are proved to be primary sources for contamination with E.coli. Inadequately cleaned and disinfected boat deck and other containers used onboard trawlers also act as sources of contamination. It goes without saying that when the temperature is also favourable, the contaminated organisms multiply rapidly and further aggravate the situation. Even though E.coli is one of the most valuable indicator organisms, it is very sensitive to processing conditions.

During icing of fish some amount of E.coli is leached out together with ice melt water. During washing with water chlorinated to a level of 10 ppm, more than 50% reduction in count takes place. About 95% reduction in E.coli count takes place during storage at -20°C and in a period of about 3 months complete destruction takes place.

Faecal streptococci:

They are gram positive nonspore forming and non-motile cocci which are found in human and animal faeces in large numbers and hence their presence in food has been well accepted as an indicator of faecal contamination. Just like E.coli, faecal streptococci are also absent in offshore waters. Unclean boat deck, utensils, water and ice are the major sources of Streptococci contamination to the product. Experiments have given clear indication that faecal Streptococci are comparatively resistant to many adverse conditions. About 30% reduction of faecal Streptococci takes place during freezing (-40°C) while during subsequent storage at -20°C not much of reduction takes place in count. Moreover faecal streptococci is also useful in determining the post process profiferation of faecal contamination in foods which cannot be detected by the use of much less resistant E.coli. These point to the superiority of faecal Streptococci as an index of faecal contamination in foods.

Comparison of E.coli and faecal streptococci as indicators of food sanitary quality

Characteristic	E.coli	Faecal Streptococci
Morphology	Rods	Cocci
Gram reaction	Negative	Positive
Incidence in intestinal tract	$10^7 - 10^9$/g of faeces	$10^5 - 10^8$/g of faeces
Incidence in faecal matter of various animal species	Absent from some	Present in most
Specificity to intestinal tract	Generally specific	Generally less specific
Occurrence outside intestinal tract	Common in low number	Common in higher number
Ease of isolation and identification	Relatively easy	More difficult
Response to adverse environmental conditions.	Less resistant	More resistant
Relative survival in frozen foods	Generally low	high
Relative survival in dried foods	low	high
Relationship to food borne intestinal pathogens	high	low

Food poisoning organisms isolated from fish and fishery products:

1.	Staphylococcus aureus	(x)
2.	Salmonella	(x)
3.	Vibrio parahaemolyticus	(x)
4.	Clostridium perfringens	(x)
5.	Enterococci	(x)
6.	Shigella	
7.	Bacillus cereus	
8.	Haemolytic streptococci	
9.	Virus of infectious hapatitis	

(x) Important

Staphylococcus aureus:

Food poisoning caused by Staphylococcus aureus is very common. Only very few people escape this in their lifetime. Almost all foods especially the cooked foods are incriminated. The causative organisms is present on human skin, in boils, carbuncles, ulcers, sweat, eargum, throat and to a great extent in the post nasal drips of human beings recovering from cold. It has been estimated that about 30% of human beings are carriers of Staphylococcus aureus. Hence human element is an important factor in fish plant sanitation where human handling is unavoidable in some stage or other. Palms of the workers having some wounds or cuts in unprotected condition may harbour many thousands of Staph. aureus which will contaminate the material during handling, of the material. Unnecessary talk during processing may result in the expellation of saliva containing Staphylococcus aureus. This may fall on the food material resulting in contamination. So improvement of worker's health, hygiene and general house-keeping are important factors to be given priority so as to avoid contamination with Staph. aureus. A few Staphylococci/g of material may be harmless but food poisoning outbreaks may happen if the product is handled carelessly during later processing so as to allow multiplication of the organisms in dangerous proportions. The organisms can multiply vigrously and produce a toxin at temperatures near and above room temperature. Hence adequate refrigeration of the material during handling and processing is highly valuable in preventing further multiplication and toxin production, Staphylococci can also grow best in foods in which the competing organisms are present in low numbers like cooked foods. Even though Staphylococcus aureus are destroyed in temperature usually applied in the kitchen, the toxin formed already can withstand 100°C for more than 3 hrs and hence are present in the material and if this exceeds 4 µg/g (4 microgram) of the product, food poisoning takes place. Vomiting, diarrhoea, general malaise prostration etc are the general symptoms which start within 1-6 hrs after consuming the infected food. Complete cure is possible within 48 hrs. During freezing (-40°C) 5-10% of the organisms are destroyed while during frozen storage it gradually disappears and in about 8 months it is completely destroyed.

The most obvious control of Staphylococcus aureus in foods is to raise the hygiene of the workers and to enforce adequate control over the holding conditions like time and temperature.

Salmonella:

Perhaps no field is more confused and complicated than that of Salmonella in food poisoning. "Salmonella" is the generic name applied to a group of bacteria which was formerly known as "paratyhoid bacteria" which was derived by D.E.Salmon in 1885. Salmonella group of bacteria is composed of many serotypes and many new ones are still being isolated.

x They are gram negative rod shaped bacteria mostly motile with the exception of S.pullorum and S.gallinarum. They do not form spores. Three clinically distinguishable forms of Salmonella are available.

1. These producing enteric fevers
a) Typhoid fever : S. typhi
b) Para typhoid fever - S.paratyphibi, A,B& C

2. Those producing septicemia - This usually happens when the organisms get into the blood eg. S.Cholerae - suis

3. These producing gastro enteritis:- All species except S. typhi and S. paratyphi produce gastro enteritis. Usually this happens on ingestion of food contaminated with Salmonella.

Primary habitat of Salmonella is the gut of man and animals especially warm blooded animals, mammals, birds and also insects, lizards and snakes. From gut it is excreted out through faeces and hence found in sewage. Some people will be carriers of Salmonella.

Beef, mutton, fish, vegetables, egg and dairy products are incriminated in Salmonella food poisoning. Among food poisoning types of Salmonella, S.typhimurium is the commonest. Other common species include S.thompson, S.newport, S.panama, S.anatum, S.saintpaul, S.enteritidis, S.seftenberg, S.dublin, S.derby and S.infants.

Symptoms: Salmonella food poisoning is caused by ingestion of foods containing sufficient number of Salmonella organisms. The onset of symptoms is usually within 12-24 hrs after consuming the infected food. Usual symptoms are nausia, vomiting, abdominal pain, headache, chills, diarrhoea, and fever. Symptoms are usually accompanied by prostration, mascular weakness, fainting,

restlesness and drowsiness, which last for 2-3 days. Mortality rate is about 4%. The highest mortality rate (21%) is reported for S.Chlerae-suis.

But in the case of enteric fever producing species of Salmonella (S.typhi) the symptoms and course of the disease are more severe. Infection is by ingestion of the organisms. From the small intestine they pass to mensentericus and after a period of multiplication they invade the blood stream and then come back to the gut. Liver, gall bladder, spleen, kidneys and bone marrow are affected. Fever, diarrhoea, restlessness, weakness, abdominal pain, severe headache and chills are the usual symptoms. Complete recovery is possible only within 20 days.

Preventive measures:

As they are pathogens of intestinal origin, improvement of personnel health and hygiene followed by adoption of necessary hygienic precautions alone can offer a permanent remedy to the problem of Salmonella in fishery products. Trimonthly medical examination of personnel handling the material, chlorination of water supply and adequate cleaning and disinfection of utensils can help a lot in the process of eradication of Salmonella.

Clostridium botulinum:

Clostridium botulinum is a food poisoning organisms which produces a very deadly exotoxin when grown in foods. One gram of Clostridium botulinum toxin is capable of killing 10^9 mice. The food poisoning is called botulisum. The first record of botulisum was in 1793 and the etiological agent was first isolated in 1895.

Clostridium botulinum is anaerobic gram positive spore forming rod and the spores are highly heat resistant. Clostridium botulinum type E is present in sea muds and is mostly involved in botulinum food poisoning in seafoods. Food poisoning is due to ingestion of toxin and not the bacterium. Hence it is a must that the infected food material may have to be held in favourable[condition for the multiplication of the spores and the formation of the toxin. Symptoms develop within 12-24 hrs. Nausea, vomiting, fatigue, headache, paralysis of the muscles, difficulty to talk, dryness of the skin, mouth and throat, double vision and sound in the ear are the usual symptoms. Death is due to respiratory failure. Mortality rate is very high (30-65%).

Clostridium botulinum food poisoning is a problem mostly in home canned foods that are improperly handled and insufficiently heat processed. Proper processing under hygienic conditions and adequate retorting will solve the problem.

Clostridium welchii:

It is a gram positive anaerobic rod shaped spore forming bacillus producing food poisoning in many kinds of foods including fish and fishery products. Unlike in the case of botulinum food poisoning, in this case the actual organisms are the cause for the poisoning. Food poisoning strains of Clostridium Welchii exist in soil, water, dust, spices and intestinal tract of man and animals. Food products contaminated with Clostridium Welchii from any of these sources multiply under favourable conditions and result in food poisoning. Upon ingestion of contaminated foods, symptoms appear between 8-22 hrs. Symptoms are characterised by acute abdominal pain, diarrhea, nausea and fever. Vomiting rarely occurs. Except in elderly or debilitated persons, the illness is of short duration of one day or less. Mortality rate is quite low or nil and no immunity seems to accur.

Improvement of sanitary conditions of the processing establishments, chlorination of water, disinfection of utensils and other food contact surfaces, and thorough check on employee hygiene and health are suggested as preventive measures to avoid problems of Clostridium welchii in fish and fishery products.

Vibrio parahaemolyticus:

This was first isolated in Japan in early 1950. Problem of Vibrioparahaemolyticus food poisoning is more in countries like Japan where there is a habit of eating raw fish. This is a gram negative, motile, non spore-forming Vibrio usually present in marine mud, plankton and sea water. It has an extremely rapid growth. It grows faster than any other organism for which growth rate has been determined. In many bacteria generation time is about 20 minutes. But in the case of Vibrio parahaemolyticus it is 7 minutes. Hence an initial contamination of fish with this Vibrio followed by improper icing will result in the multiplication of the organisms and production of food poisoning on consumption of the fish. Food poisoning in the case of Vibrio parahaemolyticus is due to ingestion of the organisms and not due to any toxin. Onset of symptom is within 12 hrs after ingestion of food. Abdominal pain, vomiting, diarrhoea and fever are the usual symptoms. It may turn fatal if proper care is not taken in time. Vibrio parahaemolyticus cannot grow below 5-8°C. Maximum temperature for growth is 45°C. At 48°C, 95% of the bacteria are inactivated. 99 9% of Vibrio parahaemolyticus are destroyed during freezing at -40°C and in storage at -20°C. The rest also will be destroyed within 10 days. Improvement of hygienic conditions and chilling the material immediately after catch are suggested as preventive measures.

Shigella:

It is a gram negative non-motile rod shaped organisms first isolated in 1898 by Kiyoshi Shiga in Japan. This organisms is more resistant to external influences than other intestinal organisms. Thermal death point is 60°C. They can survive in infected water and soil for considerable period of time. These organisms gain entrance to the body by ingestion of infected food. The organisms pass the acid barrier of the intestine and multiply in the gut and produce ulceration of the large intestine followed by dysent ry.

Bad hygienic conditions help in the spread of infection. Man is the source of infection. Food materials are contaminated by flies and man.

Preventive measures include improvement of general sanitation, protection of food from flies and control of carriers.

Bacillus cereus:

Bacillus cereus is an aerobic spore forming rod shaped bacteria normally present in soil, dust and water. This is a food poisoning organism usually creating problem in cereal dishes, mashed potatp, cornstarch and the like. Fish and fishery products are not usually incriminated. Symptoms consist of nausea, abdominal cramps and watery stools. Minimum number of organisms required to produce food poisoning is 10^7/g. Toxins are not demonstrated. The organisms cannot grow below 10°C. So proper icing can prevent multiplication of the organisms. Being a soil organism, handling of shrimp on floor of the processing hall may result in contamination with B.cereus.

Based on the aforementioned facts, methods have been developed in CIFT for prevention of bacterial contamination in fish and fishery products, two of which are given below. Method developed for cleaning and disinfection of utensils is also discussed.

Cleaning schedule for utensils and equipments in fish processing factories

1. Wash the utensils in running potable water
2. Clean with a neutral detergent to remove slime and dirt.
3. Dip in water chlorinated to a level of 100 ppm for 15 minutes.
4. Wash in potable water.

- -

Preparation of bacteriologically sound cooked peeled frozen shrimp

(Raw material whole shrimp) → (wash in potable water)
↓
(Cool in ice cold water chlorinated to a level of 20 ppm) ← (cook for 5 minutes in 7% brine)
↓
Peel (use only, washed and disinfected utensils) → (Grading)
↓
(Arrange in trays and freeze at -40°C) ← (wash 3 times in ice cold water chlorinated to a level of 10 ppm)
↓
(Store at -20° C)

Preparation of frozen froglegs free of Salmonella

1. Wash the live frogs in potable water followed by washing with water chlorinated to a level of 200 ppm.
2. Paralyse the frogs by dipping in 10% solution of common salt for 10 minutes.
3. Cut off the pair of hind legs in such a way that the intestines are least disturbed.
4. Legs with the skin are dipped in 3% brine containing 200 ppm available chlorine.
5. Remove the loosely hanging intestinal portions and wash in potable water.
6. Dip the skin-on-legs in 5% brine containing 500 ppm available chlorine for 15 minutes.
7. Remove the skin and dress the meat.
8. Remove the cloacal portion and clean.
9. Wash for three minutes in water chlorinated to a level of 200 ppm the last washing may serve as a dip for 10 minutes. It will be preferable to give a final washing with water chlorinated to a level of 10 ppm to remove any excessive smell of chlorine.
10. Wrap individually, freeze at -40°C and store at -20°C.

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KVN/

PROCESS WATER QUALITY

(FRANCIS THOMAS)

Introduction:

Water is used for a number of different purposes in the food industry. It may be an integral component of the final product, as in soft drinks and beer for example; it may come into intimate contact with the product during the manufacturing processes, as in the washing of butter. It is used for cooking purposes, for washing equipment, and in boilers and heating systems.

Standards for drinking water:

Most of the uses of water in food industry necessitate certain standards of quality. In many cases water, the standard of public supplies is quite satisfactory. Quality requirements for drinking water are given in Annexure-I. They should also be regarded as criteria for the quality of water added to foods during their manufacture or processing. But for certain industries water of a more specialised standard is required than that of some public water supplies.

The significance of the examination of water:

Water is generally examined for three types of characteristics, viz: physical, chemical and bacteriological.

I. Physical characteristics:

The main physical characteristics for which water is examined are, appearance, colour, turbidity, odour, taste and pH. Process water in seafood plants should have no noticeable colour, odour, taste and undissolved materials.

II. Chemical characteristics:

Chemical characteristics may be divided into a number of groups, main mineral constituents, constituents relating to the organic quality of the water, metals and toxic substances.

1. Main mineral constituents:

Total dissolved solids, hardness, alkalinity, chlorides and sulphates are the main characteristics determined. When large blocks of ice are frozen, the minerals dissolved in the water tend to concentrate in a core, which when solidified, becomes undesirably cloudy in appearance. Removal of the core and replacement by

fresh water can be resorted to as a means of obtaining uniformly clear blocks. The total dissolved solid content should not exceed 300 parts per million (ppm) for clean transparent ice. Hardness of water is due to the presence of bicarbonates, sulphates and chlorides of calcium and magnesium. Disadvantages of hard water are soap wastage, the production of adherent slime or curd in wash basin, baths and on textiles being laundered and the formation of scale or fur in boilers, hot water pipes and household utensils. An exceedingly soft water may have action on lead, zinc and iron. Water containing much magnesium chloride is undesirable for canning purposes, since the presence of magnesium chloride increased the risk of struvite formation. Struvite is magnesium ammonium phosphate which sometimes forms crystals resembling bits of glass in fish cans. If possible sea-water should be avoided for washing fish before canning, since sea-water contains magnesium compounds. Alkalinity above 100 ppm expressed as calcium carbonate adversely affect the quality of the frozen fishery products, the defect being bleaching on cooking. Near the sea the influex of sea water will be indicated by an increase in chlorides and hardness. Waters containing large amounts of sulphates causes diarrhoea, especially amongst children.

2. Constituents relating to the organic quality of the water:

The characteristics in the group are free and saline ammonia, albuminoid ammonia, nitrate, nitrite etc. Estimation of albuminoid ammonia is the most sensitive chemical test for organic pollution when taken in conjunction with the free and saline ammonia, nitrate and nitrite contents. The free ammonia and albuminoid ammonia contents should be considered together, since their relative proportion is more important than the actual quantities. The reasons are discussed below. In all sewages and many sewage pollution is indicated, when a natural or untreated water yields more free ammonia than albuminoid ammonia. Decaying vegetable matter in a water yields more albuminoid ammonia than free ammonia. During chlorination of water, if organic matter is present in water, its demand must be satisfied before any chlorine is available for germicidal action. The presence of free and saline ammonia in amounts more than traces cause considerable retardation of sterilisation. [illegible] The more efficient the progress of sewage purification, the less is the amount of nitrogen as free ammonia, and greater the amount of nitrogen as nitrates and nitrites. Nitrifying organisms convert free ammonia into nitrates, while ferruginous sands convert nitrates into ammonia.

3. Metals:

Apart from the main cations present in water, ie, calcium, magnesium, sodium and potassium, the following metals may also

effluents the amount of free ammonia greatly exceeds that of the albuminoid ammonia. In the crude sewage the free ammonia is 2½ times as great as the albuminoid ammonia. Hence in many cases sewage

be found viz: Iron, manganese, zinc and copper. The presence of iron and manganese in water is objectionable owing to the production of discolouration, turbidity, deposit and taste. When meant for canning operations, the copper level should be less than 0.1 ppm as higher amounts may cause blackening of canned shrimp. The presence of copper or iron in water used for processing fatty fishes is objectionable, since these metals may hasten the rancidity development of such fishes.

4. Toxic substances:

The main characteristics in the group are fluoride, cyanide, lead, arsenic, hexavalent chromium, silver, selenium, cadmium and barium. It has been established that the presence of incorporation of a small amount of fluoride in drinking water reduces the incidence of dental caries in growing children. Mottled enamel, a defect in teeth, has been attributed to fluoride in drinking water. The minimum quantity of fluoride in water to give rise to mottled enamel is from 1 to 2 ppm. Cyanide is extremely poisonous. Lead and arsenic are cumulative poisons. Toxic action of chromium is confined to hexavalent compounds of chromium. Silver is cumulatively stored in the body. Excessive intake of silver may lead to argyria (a permanent disfigurement in the form of a darkening of the skin). Selenium is one of the essential elements and is also labelled as a carcinogen. Cadmium is considered an element of high toxic potential. Even though barium is found in traces in most human tissues, it is considered as a toxic element.

The bacteriological examination of water:

Contamination by sewage or by human excrement is the greatest danger associated with drinking water. For routine control purposes, the direct research for the presence of specific pathogenic bacteria is impracticable, water being examined for evidence of pollution by excremental matter of human or animal origin. The assumption is made that if this type of pollution occurs, the water must be regarded as potentially dangerous. Attention is mainly paid to bacterial species of known excremental origin, particularly Escherichia coli (and other numbers of coliform group), faecal streptococci and Clostridium perfringens (Chlostridium welchii). These organisms are easier to isolate and identify. The presence of normal faecal organisms in a water sample indicates that pathogens could be present. The absence of faecal organisms indicates that pathogens also are probably absent. The use of contaminated water in the preparation of food may allow the multiplication of intestinal pathogens and hence is harmful.

The organisms most commonly used as indicators of faecal pollution are the coliform group as a whole, and particularly Escherichia coli. E.coli is the most frequent type of coliform organisms present in human intestine. This micro-organism is being found in numbers upto 100 or even 1000 millions per gram

of fresh faeces. Apart from excreted contamination it is rarely found in soil, vegetation or water. Coliform organisms other than E.coli also occur in the intestinal canal. But their combined numbers seldom exceed one million organisms in nature suggests that they may all be primarily faecal organisms but that outside the body types other than E.coli have greater powers of survival and can multiply in certain circumstances.

The greatest value of faecal streptococcus test lies in assessing the significance of doubtful results from the coliform test, particularly the occurrence of large number of coliforms in the absence of E.coli. The presence of streptococci would confirm the faecal origin of the pollution.

The test for Clostridium perfringens has uses similar and additional to the examination for faecal streptococci. Clostridium perfringens forms spores which survive for a much longer time than the vegetative organisms of the coliform group. The presence of Clostridium perfringens in the absence of coliform organisms indicates that the contamination has occurred at some remote time. In the absence of E.coli, the occurrence of Clostridium perfringens in water together with coliform organisms suggest that faecal pollution has not been recent.

Colony counts are not essential for assessing the safety of domestic water supplies. They are useful for indicating the efficiency of certain processes in water treatment and cleanliness of the distribution system. In some water supplies, rising colony counts may give the earliest sign of pollution. They are also useful for determining the suitability of a water supply for large scale preparation of food and drink. In these cases the water should ideally contain few organisms of any kind in order to avoid the risk of spoilage. During canning cans are cooled by water either inside or outside the retort. Then care should be taken to ensure that the water used is pure. As the cans are cooled, pressure inside changes rapidly and under such conditions even a correctly made seam may allow the passage of a trace of water which, if it is contaminated, may give rise to spoilage during subsequent storage.

The tolerances for bacteriological quality in "Indian Standard quality tolerances, for water and ice manufacture' are the following.

a) Coliform bacteria index per 100 ml (Max) $>$ 1
b) Standard plate count (Max) 100

The treatment of water to make it potable involves the physical removal of enteric pathogens or their chemical destruction. Chlorine gas, liquid chlorine, and various chlorine compounds have been employed for the treatment of public water supplies. Free chlorine has a bactericidal power upto 200 times that of phenol. The firmness with which the chlorine is bound to other substances or elements determines how effective the chlorine is going to be in killing germs. Loosely bound chlorine, such as that found in calcium hypochlorite, can be active in killing organisms. Chlorine can combine directly with protein in a process called chlorination, or it may act by oxidation. In both cases, the living cells normal protoplasmic balance is disrupted and the cell eventually dies. The concentration of chlorine required to satisfactorily disinfect water isusually not over 1 ppm, with a residual level of 0.1 to 0.3 ppm at distant points through out the distribution system.

In plant chlorination of processing water is employed in many food industries. In cannery and freezing plant the in-plant chlorination of processing water aids in reducing bacterial contamination throughout the plant. Chlorination makes it easier to remove such slime that may have developed on plant equipment. This is due to the fact that such slimes as may have developed does not adhere so tenaciously. So the clean-up crew can do more thorough work in a shorter time period. The levels of chlorine required in water during the various stages of processing seafood is given in the Annexure II.

Sodium hypochlorite solution is generally used by the fish processors in India for chlorination of water for processing purposes. The method for the estimation of available chlorine in sodium hypochlorite solution is as follows. For strong solutions, pippette 10 ml into a 250 ml graduated flask containing about 100 ml of distilled water, keeping the tip of the pipette beneath the surface of the water. Dilute to the mark and mix thoroughly. Use an aliquot portion for the determination. For weak solutions (below 3.5% available chlorine) use the sample as received. Dissolve 2-3 gms of potassium iodide crystals in 50 ml of distilled water in a 250 ml Erlenmeyer flask. Introduce the sample under the surface of the solution (The volume of the sample should be such that it will titrate about 40.0 ml of N/10 sodium thiosulphate solution). Acidity slightly with acetic acid. Titrate with N/10 sodium thiosulphate until the yellow colour of iodine is nearly destroyed. Add 5 ml of starch solution and titrate until the blue colour entirely disappears.

Available chlorine in sodium hypochlorite

$$\text{solution} = \frac{\text{ml N/10 sodium thiosulphate} \times 0.3546}{\text{ml of sample}} \ \% \ (W/V)$$

Waters of different chlorine levels can be prepared with the help of a chlorine chart.

ANNEXURE I

STANDARDS FOR DRINKING WATER

Test	W.H.O. Max. acceptable concentration	W.H.O. Max. allowable concentration	U.S.P.H.S.
Colour (Hazen or Platinum - cobalt scale unit)	5	50	Not exceeding 15
Turbidity units	5	25	Not exceeding 3
Odour	Unobjectionable	--	Not exceeding threshold odour number of 3 units
Taste	Unobjectionable	--	
Iron (Fe)	0.3 mg/l	1.0mg/l	Not exceeding 0.3 mg/l
Manganese (Mn)	0.1 mg/l	0.5mg/l	Not exceeding 0.05 mg/l
Copper (cu)	1.0 mg/l	1.5mg/l	Not exceeding 1.0 mg/l
Zinc (Zn)	5.0 mg/l	15mg/l	Not exceeding 5.0mg/l
Calcium (Ca)	75 mg/l	200mg/l	--
Magnesium (Mg)	50 mg/l	150mg/l	--
Sulphate (SO_4)	200 mg/l	400mg/l	Not exceeding 200mg/l
Chloride (Cl)	200mg/l	600mg/l	Not exceeding 200mg/l
Phenols	0.001mg/l	0.002mg/l	Not exceeding 0.001mg/l
Alkyl benzene sulphonate	0.5mg/l	1.0mg/l	Not exceeding 0.5mg/l
Carbon-chloroform extract	0.2mg/l	0.5mg/l	Not exceeding 0.2mg/l
Nitrate (NO_3)	--	45mg/l	Not exceeding 45mg/l
Fluoride (F)	1mg/l	1.5mg/l	1.7mg/l (at an average/ maximum daily air temperature of 50-54°F) down to 0.8 mg/l (at temperature of 79.3-90.5°F)

Test	Maximum allowable concentration W.H.O.	U.S.P.H.S.
Toxic substances		
Arsenic (As)	0.05 mg/l	0.05 mg/l
Barium (Ba)	1.0 mg/l	1.0 mg/l
Cadmium (Cd)	0.01 mg/l	0.01 mg/l
Chromium (Cr)	0.05 mg/l	0.05 mg/l
Cyanide (Cn)	0.2 mg/l	0.01 mg/l
Lead (Pb)	0.05 mg/l	0.05 mg/l
Selenium (Se)	0.01 mg/l	0.01 mg/l
Silver (Ag)	---	0.05 mg/l

"Maximum acceptable concentration" applies to a water generally acceptable by consumers. "Maximum allowable concentration" values greater than those listed would markedly impair the potability of the water.

Arsenic should not be present in a water supply in excess of 0.01 mg/l where other more suitable supplies are or can be made available.

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ANNEXURE II

Recommended level of available chlorine in water used for seafood processing

Stage of processing	Recommended level of available chlorine in ppm
1. Factory sanitation:	
The water used in the processing plant	5-10 ppm
For ice manufacture	5-10 ppm
For washing contaminated ice before using with the fish	5-10 ppm
For washing the fish processing factories and primary processing centres after applying a suitable detergent	
[illegible]	[illegible] ppm
To disinfect floor surfaces, gutters etc[1]	500-800 ppm
For final washing	10 ppm
To disinfect boat decks, fish holds, wooden boxes etc.[2]	1000 ppm
For spraying fish containers, fish carrier vans and refrigerated wagons in order to remove fish smell	100 ppm
To disinfect washed utensils coming in contact with seafood	100 ppm
To disinfect workers washed hands	200 ppm
2. Cooked frozen prawns:	
For cooling cooked material	10 ppm
For dipping the material before packing[4]	20 ppm
For glazing	10 ppm
For reglazing	20 ppm
3. Canned seafood:	
For cooling processed cans	3 to 5 ppm

4. Frozen froglegs:

For washing the live frogs	200 ppm
In 5% common salt solution used for keeping the severed legs for proper bleeding	200 ppm
For washing the froglegs before storing in ice for transportation to the freezing plant	200 ppm
In 5% common salt solution used for dipping the froglegs before skinning and trimming	500 ppm
For washing each pair of leg after skinning and trimming	200 ppm
For dipping the washed legs [5]	200 ppm
For washing these legs in order to remove the excessive smell of chlorine	5 ppm
For dipping the polythene paper prior to wrapping individually	200 ppm

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QUALITY STANDARDS, METHODS OF TEST AND ANALYSIS

A.G.JOSEPH

Introduction:

The subject of food standard is generating considerable interest at the present time among processors, dealers and consumers. Various meanings have been applied to the term 'standard' but here it is meant to refer to a reasonably complete and widely applied food product specification that has been agreed nationally or internationally. Since the fish trade is becoming increasingly international the need for the formulation of both national and international standards for fish and fishery products has become increasingly important. Standardization of fish and fishery products is generally designed to serve the following purposes.

1. To ensure that the product has been prepared from quality raw materials and that it has never been grossly contaminated.
2. To ensure that the product is absolutely free from pathogens or toxins of public health significance.
3. To ensure that the product was processed under ideal conditions.
4. To ensure that the product has a reasonably extended shelf-life.

National standards:

The Indian Standard Institution (ISI) which started functioning in 1947, is the national standards organisation for India. Its principal object is to prepare standards on national and international basis, and promote their general adoption.

The overall control of ISI which is run and financed jointly as a non-profit making body by the Union Government and private enterprise, is exercised by a general council, composed of representatives of Central and State Governments; leading trade, scientific and technological organisations, and subscribing members. The Union Minister for Industry is the ex-officio president of ISI.

The present technical activity of ISI is carried out through its various division Councils. The technical work relating to the formulation and revision of standards on fish and fishery products is done by the Committees under the Division Council for Agricultural and Food Products. The Committees consist of experts drawn from manufacturing units, technical institutions, purchase

organisations and other concerned bodies. These standards prescribe detailed requirements of processing, packaging and methods of analysis for evaluation of quality of the products. So far more than 42 standard specifications have been brought out by ISI in the field of fish and fishery products (Table I).

International Standards:

1. European Economic Community: The nine EEC countries adopted a mandatory regulation which controls the grading system at first sale of chilled fish.

2. Codex Alimentarius and Codex Standards: The importance of an international standardization of food products was recognized by the establishment of a European Codex Alimentarius in 1958. Soon the need for a broader international approach was realized and as a result of this Food and Agriculture Organisation (FAO) and World Health Organization (WHO) two important organisations of United Nations, jointly convened an international meeting of Government representatives to consider a proposal for establishing a Codex Alimentarius. This meeting recommended the establishment of a Codex Alimentarius Commission. Today its work is part of activities of FAO and WHO. The purpose of the Codex Alimentarius is to collect internationally adopted food standards and present them in a uniform manner. The Codex Alimentarius also includes provisions of an advisory nature in the forms of codes of practice, guidelines and other recommended measures intended to assist in achieving the purpose of Codex Alimentarius.

The Codex Committees are subsidiary bodies of Codex Alimentarius. The Codex Committee on Fish and Fishery Products was able to initiate the preparation of nearly twenty standards. Some of these have been advanced to the final step and others are in various stages of finalization.

Salient Features of the National Standards:

The Indian Standard specifications for fish and fishery products have the following parts (1)scope of the standards (2)Terminology (3)Grades (4)preparation of the material (5)Requirements (6)packing and marking (7)sampling (8)tests. The requirements of the products can be divided under four heads as follows 1.Requirements for physical aspects like weight, size etc. 2.Chemical characteristics like sodium chloride content, acid content, metal content, sand content etc. 3.Microbiological requirements relating to the maximum total

numbers of bacteria and particular types of bacteria 4.organoleptic criteria relating to appearances, colour, texture, odour and flavour. Each group of products and their minimum requirements are in general, as follows:

A. Fresh Fish:

There are only four products for which specifications are available under this group. They are pomfrets, thread-fin, mackerel and seerfish. The physical quality requirements for fresh fish relate to the species, size, temperature of the fish, method of icing, freedom from spoilage as examined visually - the gills, eyes, belly cavity etc. The organoleptic aspects are colour, odour, flavour and texture of cooked muscle. The microbiological requirements are given in table II.

B. Frozen fish and shell fish:

Indian standard specifications are available for shrimp, froglegs, lobster tails, pomfrets, threadfin, mackerel and seerfish, cuttle fish and squid. Because of the export performance, shrimp, froglegs, lobster tails, cuttlefish and squid received better attention with regard to quality. The main quality requirements for these frozen commodities relate to dehydration drained weight, size, grade, discolouration, deterioration, organoleptic characteristics and microbiological requirements. The organoleptic requirements are given in table III and microbiological requirements are shown in table II.

C. Canned fish and shell fish:

The products covered by Indian standards in this group are pomfret in oil, prawns in brine, mackerel in oil and brine, sardines in oil, sardines in brine and in their juice, lactarius and tuna in oil, crab meat in brine and crab meat solid packed. Of these, the greatest attention probably paid to prawns in brine because of the stringent quality specified by the foreign buyers.

The quality requirements of canned products usually relate to the external appearance of the can, vacuum, fill volume and its nature, drained weight, foreign material, texture, colour, odour and flavour, nature of the can interior and microbiological requirements. These are shown in table IV.

D. Dried fish and shell fish:

The products covered by Indian standards in this group are dried prawns, dried white baits, dried and laminated bombay duck,

dry salted mackerel, dry salted seerfish, dry salted shark, dry salted tuna, dry salted threadfin and dry salted jew fish, dry salted catfish, dry salted leather jacket, dry salted horse mackerel, dried sharkfin and fish maws. These products are important both in internal and export trade. The requirements mainly relate to size, moisture, freedom from excessive sand and salt, absence of deterioration, freedom from infestation with fungus and mites etc. Requirements relating to moisture, salt and acid insoluble ash (sand) are shown in table V.

E. Miscellaneous:

The Indian standard specification for fish meal as livestock feed specifies maximum moisture and fat contents of 10% each and minimum protein content of 50%. The maximum sand content is 5%. The specifications for sardine oil and shark liver oil for veterinary use relate to the degradation products, colour, taste, saponification and iodine values and of stearin content. The code for hygienic conditions for fish processing industry and basic requirements for fresh fish stalls and fish markets are of paramount importance in keeping the products microbiologically safe. These recommendations are based on the experience gained in our fish processing industry and is found to be effective in producing microbiologically safe products.

Methods of analysis:

1. Physical aspects:

a) Count:- It is determined by dividing the number of shrimp or fish in the package by the actual net weight.

b) Net weight:- The frozen products are first thawed by keeping in flowing water kept at 75° to 85°F. It is then drained in a sieve for 2 minutes and the weight is determined.

c) Drained weight of the contents in a can shall be obtained after draining the contents of the can for 5 minutes on 2.00 mm IS sieve.

2. Chemical characteristics:

a) Sodium chloride in brine

The brine in the can is quantitatively transferred into a 1000 ml standard flask by repeatedly washing the contents of the can and inside of the can with distilled water and the volume is made upto 1 litre.

A known volume of the above brine solution is treated with a known volume of the standard silver nitrate solution, in slight excess in presence of dilute nitric acid. It is then boiled for 15 minutes, cooled, diluted with water and the excess silver nitrate is titrated against standard ammonium thiocynate solution using ferric alum as indicator.

b) Acid in brine:

A known volume of the above brine solution is titrated against standard sodium hydroxide solution using phenolphthalein as indicator. The percentage acidity is then calculated from the relationship 1 ml of 0.1N sodium hydroxide solution is equivalent to 0.0064 gm of citric acid (anhydrous).

c) Heavy metals in canned products:

Heavy metals like Arsenic, lead, copper, zinc and tin in canned products are estimated as per the methods given in IS:2168-1962.

d) Moisture:

A known weight (Ca 10 g) of the pulvarised sample in a silica cruicible is heated in an air oven kept at 100 $\pm$ 2°C till constant weight is obtained.

e) Sodium chloride in fish meal and dried products:

The method described in the case of brine is followed here also. But instead of brine a known weight (Ca 2-4 gm) of the sample is taken.

f) Acid insoluble ash (sand):

A known weight (Ca 2 g) of the sample is incinerated in a muffle furnace at 600°C $\pm$ 20°C until free from all carbonaceous material and the ash is white or greyish white. The ash is then repeatedly boiled with minor quantities of 1:1 HCl, filtered through an ashless filter paper, washed till free of chlorides, again ignited at 600°C $\pm$ 20°C, cooled and weighed.

g) Crude protein in fishmeal:

The percentage of crude protein is ascertained by multiplying the percentage of nitrogen other than ammoniacal nitrogen by 6.25. The quantity of ammoniacal nitrogen is separately determined and deducted from the total nitrogen.

i) Total nitrogen: A known weight (Ca 0.5 g) of the sample is digested with concentrated sulphuric acid and a pinch of digestion mixture in a Kjeldahls digestion flask till the solution is clear. It is then cooled, made up to 50 or 100 ml in a standard flask. A known volume of this solution is distilled with sodium hydroxide solution in a Micro-Kjeldahls distillation unit. The liberated ammonia is absorbed in 2% boric acid and is then titrated against $\frac{N}{50}$ sulphuric acid. The nitrogen is calculated from the relationship 1 ml of $\frac{N}{50}$ sulphuric acid = 0.28 mg of nitrogen

ii) Ammoniacal nitrogen: A known weight of the sample is shaken with water, filtered and the filterate is distilled by Micro-Kjeldahlsmethod as described above.

h) Crude Fat:

A known weight (Ca 5g) of the sample is extracted with petroleum ether for about 8-12 hrs in a soxlet extractor. The extract is dried on steam-bath, cooled and the weight is taken.

3. Microbiological Analysis:

Both quantitative and qualitative analysis are carried out to determine the bacterial quality of fish and fisheries products. The quantitative tests seek to estimate the total bacterial count (standard plate count) and the numbers of certain specific micro-organisms like E.coli, Coagulase positive staphylococci and faecal streptococci. The qualitative test involves the detection of certain types of micro-organisms like Salmonella.

Procedure:

Disintegrate about 10 g of asceptically collected sample with 90 ml of sterile phosphate buffer in a sterile blender or sterile glass mortar. Decimal dilutions are poured into sterile petri dishes and appropriate media are added except in the case of surface streaking method where 0.5 ml of the dilutions is added to petridishes containing the surface dried medium.

a) Total Bacterial Count: Tryptone glucose ggar is mainly used for the determination of total bacterial count. The petridishes after setting the agar, are incubated at 37°C for 48 hrs after which the colonies are counted and bacterial count per gram is calculated.

b) Escherichia Coli:

Surface streaking technique using Tergitol agar is employed for the determination of E.coli. The plates are incubated at 37°C for 18-24 hrs and the characteristic yellow colonies are counted.

c) Coagulase positive staphylococci:

Surface streaking technique using Baird parker medium is employed for the determination of this organisms. The plates are incubated at 37°C for 24 to 36 hrs and the black colonies surrounded by a clear zone of hydrolysis are counted as coagulase positive staphylococci. In doubtful cases further confirmation may be done by plasma coagulation test.

d) Faecal streptococci:

The KF agar of Kenneret al is used for the determination of this organism. The petridishes are incubated at 37°C for 48 hrs and the characteristic red and pink colonies are counted.

e) Salmonella:

Sample is first enriched in lactose broth or tryptone broth followed by a second enrichment in selenite cystine broth and tetrathionate broth. One loopful each from the above broths are streaked on to plates of brilliant green agar, Bismuth sulphate agar and salmonella shigella agar. The positive colonies from the above plates are streaked on to triple sugar iron agar (TSI) slants. The positive cultures from the TSI slants are further confirmed by biochemical and serological tests using salmonella polyvalent 'O' and 'H' sera.

f) Determination of commercial sterility of canned products:

The cans are incubated at 37°C and 55°C for not less than 14 days. The cans are then asceptically opened and 1 ml of the liquid portion of the can is transferred to 10 ml of sterile sodium thioglycollate broth and the broth is then incubated to observe the growth. A positive test indicates that the can is commercially non-sterile.

4. Tests for organoleptic characteristics:

Colour, odour, flavour and texture on thawed material after cooking is determined as follows.

A transverse section of the fish or peeled and deveined prawns is kept in a suitable container like the boilable plastic bag with some salt for taste. The bag is suspended in boiling water for varying lengths of time depending on the size of the prawns or until the internal temperature of the muscle reaches 70°C in about 20 minutes in the case of fish. The material is then cooled and the colour, odour, flavour and texture are then determined.

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TABLE I

INDIAN STANDARDS ON FISH & FISHERIES PRODUCTS

Sl.No.	Name of specifications	Specification Number and year of publication
1	2	3
	A. Fresh Fish	
1.	Fresh silver pomfret and brown pomfret	IS 4780-1968
2.	Fresh threadfin	IS 4781-1968
3.	Mackerel, fresh	IS 6032-1971
4.	Seer fish(Scomberomorus spp.) fresh	IS 6123-1971
	B. Frozen fish & shell fish	
5.	Frozen prawns (shrimp) first revision	IS 2237-1971
6.	Frozen froglegs	IS 2885-1964
7.	Frozen lobster tails	IS 3892-1966
8.	Frozen threadfin	IS 4796-1968
9.	Frozen silver pomphrets and brown pomfrets	IS 4793-1968
10.	Mackerel, frozen	IS 6033-1971
11.	Seer fish(Scombermorus spp), frozen	IS 6122-1971
12.	Frozen cuttlefish and squid	IS 8076-1976
	C.Canned fish & shell fish	
13.	Pomfret canned in oil (first rivision)	IS 2168-1971
14.	Prawns (shrimp) canned in brine(first revision)	IS 2236-1968
15.	Mackerel (Rastrelliger spp) canned fish in oil (first revision)	IS 2420-1971
16.	Mackerel (Rastrelliger spp) canned in brine	IS 3849-1966
17.	Sardines(Sardinella spp)canned in oil (first revision)	IS 2421-1971
18.	Sardines(sardinella spp.) canned in brine and in their juice	IS 6677-1972
19.	Lactarius spp. canned in oil	IS 6121-1971
20.	Tuna canned in oil	IS 4304-1967
21.	Crab meat, canned in brine	IS 7143-1973
22.	Crab meat, solid packed	IS 7582-1975
	D. Dried fish & shell fish	
23.	Dried prawns (first revision)	IS 2345-1972
24.	Dried white baits(Anchoviella spp.)	IS 2883-1964
25.	Dried and laminated Bombay duck	IS 2884-1964
26.	Dry salted mackerel	IS 4302-1967

27. Dry salted seer fish	IS 5198-1969
28. Dry salted shark	IS 5199-1969
29. Dry salted SURAI (Tuna)	IS 5736-1970
30. Dry salted thread fin (Dara) and dry salted jew fish (GHOL)	IS 3850-1973
31. Dry salted cat fish	IS 3851-1966
32. Dry salted leather jacket(chlorinemus spp.)	IS 3852-1966
33. Dry salted horse mackerel(Caranx spp.)	IS 3853-1967
34. Dried shark fin	IS 5471-1969
35. Fish maws	IS 5472-1969

E. Miscellaneous

36. Code for hygienic conditions for fish industry part 1 pre-processing stage(first revision)	IS 4303-1975
37. part II -----do-----(canning stage) (first revision)	IS 4303-1975
38. Recommendation for maintenance of cleanliness in fish industry	IS 5735-1970
39. Fish meal as livestock feed(first revision)	IS 4307-1975
40. Shark liver oil for veterinary use	IS 3336-1965
41. Sardine oil	IS 5734-1970
42. Glossary of important fish species of India	IS 7313-1974
43. Basic requirements for fresh fish stalls	IS 7581-1975
44. Basic requirements for a fish market	IS 8082-1976
45. Procedure for checking temperature of quick frozen foods	IS 8077-1976
46. Master cartons for export of frozen seafoods and frog legs	IS 6715-1972

TABLE II

MICROBIOLOGICAL REQUIREMENTS FOR FRESH AND FROZEN FISH AND SHELL FISH
(Bacterial count maximum /g)

Sl.No.	Name of fish/shell fish	Fresh/Frozen	SPC	E.coli	Coagulase positive Staphylo-cocci	Faecal strep-cocci	Salmonella
1.	Mackerel	Fresh	1,00,000	20	---	---	Nil
2.	Threadfin	Fresh	1,00,000	20	---	---	,,
3.	Pomfrets	Fresh	1,00,000	20	---	---	,,
4.	Mackerel	Frozen	1,00,000	10	---	---	,,
5.	Threadfin	Frozen	1,00,000	10	---	---	,,
6.	Pomfrets	Frozen	1,00,000	10	---	---	,,
7.	Seer fish	Frozen	1,00,000	10	---	---	,,
8.	Froglegs	Frozen	5,00,000	10	---	---	,,
9.	Lobster tails	Frozen	5,00,000	20	100	---	,,
10.	Prawns (whole & headless)	Frozen	5,00,000	20	100	100	,,
11.	Prawns (peeled & deveined)	Frozen	10,00,000	20	100	100	,,
12.	Prawns (cooked)	Frozen	1,00,000	Nil	100	100	,,
13.	Cuttle fish	Frozen	1,00,000	10	100	---	,,

TABLE III ORGANOLEPTIC REQUIREMENTS OF SHRIMP

S.No.	Characteristic	whole type and HL type	Requirements for peeled and deveined type including Butterfly and Fantail and peeled and undeveined	Cooked type includin cooked peeled, peele cooked, and peeled Deveined-Cooked
1.	Colour of shell	Natural colour-slightly dim or faded	---	---
2.	Colour of flesh	Characteristic of freshly caught prawns-slightly discoloured	Characteristic white colour-faded or slightly yellowish	Characterist:-slightl faded
3.	Black discolour-ation of shell or meat	Nil-at the shell joints only	Nil	Nil
4.	Texture of meat	Firm and consistent. Not mashy but tending to become loose	Firm and consistent-slightly mashy but not loose	Firm and consistent-fi but breaking into piec when pressed between the fingers
5.	Odour	Characteristic odour-No off odour	No off odour	Odour of fresh cooked prawns-No off odour
6.	Flavour on cooking	Characteristic of freshly cooked prawns-No off flavour	Characteristic of freshly cooked prawns-No off flavour	Characteristic of prawn flavour-No off flavour

TABLE IV : QUALITY REQUIREMENTS OF CANNED PRODUCTS

Sl.No.	Characteristic	Requirements for Tuna O	Prawn B	Pomfrets O	Mackerel B	Mackerel O	Sardine B	Sardine O	Lactarius spp O	Crab B
1.	Can exterior	shall not be rusted, dented or bulged								
2.	Vacuum in mm(min) for round cans:	100 in all cases or negative pressure in flat cans								150
3.	Head space mm	5-10 in all								
4.	Drained weight of the contents of the can as % of water capacity	70	64	66	65	65	70	70	65	65
5.	Proportion of water in drained liquid(max)	5	--	10	--	10	--	10	10	--
6.	Disintegrated portion as % of drained weight (max)	5	5	5	5	5	5	5	5	--
7.	Trace elements ppm (max)	Cu 12 A 1 Pb 5 Zn 50 S 250								
8.	Can interior	Normal i.e. free from discolouration etc.								
9.	Microbiological activity	Absent in all cases								

O = oil pack
B = Brine pack

IN-PLANT INSPECTION - FROM FISHING BOAT TO THE END PRODUCT

CYRIAC MATHEN

A system of Compulsory Preshipment Inspection for major seafood items meant for export has been in operation since 1965. This system has the merits and demerits of an end product inspection system. One of the merits of this system is the limited staff requirement. However, rejections due to quality defects are not very low. At least 10% of the products are sub-standard indicating losses incurred in producing a substandard product. The end product inspection system looks for conformity of the end product to the notified requirements and it cannot enquire into the conditions under which these products have been manufactured. It is possible that in some cases the handling and processing received by the raw material are not according to good manufacturing practices. Many a defect can be camouflaged by a few drastic treatments and this may deceive the Quality Inspection. Further, purposeful inclusion of substandard material in a consignment of good quality product is also not ruled out. Since the actual processor has very little control over the raw material, he is forced by the rules of supply and demand to accept raw materials of doubtful quality. This gives the raw material supplier more confidence that he can sell even doubtful quality material. Thus he too relaxes his control over raw material quality. If every processor hesitates to buy poor quality raw material, the supplier is forced to keep up quality. The present attempt to introduce in plant inspection, or better in process inspection, will probably be an enforcement on the processor not to buy sub-standard raw material, thus contributing towards the morale of the raw material supplier to be more careful about the quality of what he supplies. It will also force the processor to adhere to good manufacturing practices. The Quality Inspector will be taking up the role of a factory quality controller thus filling up this gap in the present industrial set up. In the proposed set up, the inspection is to start as the material reaches the factory premises. It is generally understood that quality deterioration of raw material after its receipt in the processing factory rarely occurs. Howeger, certain faulty operations, either due to ignorance or due to negligence can result in poor quality end product. Hence to improve the quality i.e., to reduce rejections to zero percent and to raise the overall quality level, inspection is to start right from harvesting.

In an in-process inspection several points of significance have to be considered. These points are enumerated below:

		Yes/No	Remarks
0.0	On board the fishing vessel		
0.1	Size of the craft		
0.2	Is the vessel cleaned and disinfected before it leaves for fishing?		
0.3	Is the water used in cleaning bacteriologically sound?		
0.4	Is the material of construction of the boat deck free from crevices, rust etc and easily cleanable?		
0.5	Is there storage facility for the catch?		
0.6	Are the containers used to handle and store the catch made of easily cleanable material?		
0.7	Are bamboo/cane baskets used in handling of the catch?		
0.8	Is the deck flushed with clean seawater before each haul reaches the deck?		
0.9	Is washing and sorting of the catch done on board?		
0.10	Do the catch remain on the deck exposed to adverse elements of nature for unduly long periods?		
0.11	Do the boat carry ice?		
0.12	If not, is the time lag between catch and landing sufficiently short to retain the freshness?		
0.13	Is ice left over after a fishing trip used in the next trip?		

		Yes/No	Remarks
0.14	Are the catches from different hauls/days separately kept?		
0.15	Is any processing done on board? note.		
0.16	Is near shore water used for cleaning of boat decks or for washing the catch?		
0.17	Any other points of significance to quality?		
1.0	Unloading & Transportation to the processing plant:		
1.1	Is the mode of unloading satisfactory?		
1.2	Do the catch remain at the landing site without ice for unduly long periods?		
1.3	Is there any possibility of contamination with extraneous material in the method of unloading and handling?		
1.4	Is the material properly iced before loading for transportation?		
1.5	Are the containers used for icing and transport satisfactory in quality?		
1.6	Is the conveyance properly covered to protect the containers from adverse elements of nature?		
1.7	Any other points of interest		
2.0	Surroundings of the peeling shed/processing plant:		
2.1	Are the premises kept clean?		
2.2	Are there any swamps, stagnant water or dumps nearby?		
2.3	Is rubbish and offal stored properly, pending disposal?		
2.4	Is rubbish and offal disposed off properly?		

		Yes/No	Remarks
2.5	Are the roads in the premises concreted/tarred or turfed to prevent wind blown dust?		
2.6	Are there signs of any rodent harbourage nearby?		
2.7	Are there any animals housed nearby?		
2.8	Are the ground conditions of approaches and surroundings satisfactory?		
3.0	Plant		
	Are there adequate facilities for-		
3.1	Raw material receiving?		
3.2	Peeling and preprocessing?		
3.3	Processing?		
3.4	Ice manufacture?		
3.5	Freezing?		
3.6	Canning?		
3.7	Frozen storage?		
3.8	Can storage?		
3.9	Toilet/Personal hygiene?		
3.10	Others(specify)		
4.0	Raw Material Receiving Section:		
4.1	Are the floor corners rounded off?		
4.2	Is the floor smooth?		
4.3	Is the floor clean?		
4.4	Are the walls smooth?		
4.5	Are the walls washable?		

		Yes/No	Remarks
4.6	Is the ceiling clean and in good condition?		
4.7	Are the doors and windows clean and in good condition?		
4.8	Is rodent and fly proofing satisfactory?		
4.9	Is drainage facility adequate?		
4.10	Is there adequate lighting?		
4.11	Is there adequate ventilation?		
4.12	Mode of transport used for bringing raw material		
4.13	Details of containers used (specify)		
4.14	Is the raw material - a) Properly washed? b) Adequately iced?		
4.15	Temperature of the raw material		
4.16	Is chill room provided for storing raw material?		
4.17	Is quality of the raw material acceptable?		
4.18	Is the raw material hygienically stored?		
4.19	Any other aspect that might cause sanitary problem (specify)		
5.0	Peeling/Pre-Processing Section:		
5.1	Does the location cause any sanitary problem?		
5.2	Is there adequate lighting?		

		Yes/No	Remarks
5.3	Is any light suspended over the working table; if so, are they sufficiently protected?		
5.4	Are the floor corners rounded off?		
5.5	Is the floor smooth?		
5.6	Is the floor clean?		
5.7	Are the walls smooth?		
5.8	Are the walls washable?		
5.9	Is the ceiling clean and in good repair?		
5.10	Are the doors and windows clean and in good condition		
5.11	Is rodent and fly proofing satisfactory?		
5.12	Is drainage facility adequate?		
5.13	Is there adequate ventilation?		
5.14	Is peeling conducted on tables?		
5.15	Are they provided with chutes to remove waste?		
5.16	Are the tables clean?		
5.17	Do the workers squat on the floor?		
5.18	Is the quality of the water used satisfactory?		
5.19	Is the quality of the ice used satisfactory		
5.20	Are facilities for waste disposal satisfactory?		
5.21	Are utensils properly kept clean?		

		Yes/No	Remarks
5.22	Nature of containers used(construction, material, design etc.)		
5.23	Is facility for feet and hand washing available?		
5.24	Are the workers provided with aprons and head covers?		
5.25	Is peeled material stored satisfactorily?		
5.26	Is supply of water adequate for peak loads?		
5.27	Is there a prescribed cleaning schedule?		
5.28	Any other aspect that might cause sanitary problem (specify)		
6.0	Processing Section:		
6.1	Construction and design		
6.1.1	Does it prevent wind blown dust and debris?		
6.1.2	Is it rodent and flyproof?		
6.1.3	Are the floor corners rounded off?		
6.1.4	Is the floor smooth and impermiable		
6.1.5	Is the floor clean?		
6.1.6	Are the walls smooth?		
6.1.7	Are the walls washable upto height of not less than 1.30 mtrs?		
6.1.8	Is the ceiling clean and in good condition?		
6.1.9	Do overhead rafters offer any runway for lizards, cockroaches etc.?		

		Yes/No	Remarks
6.1.10	Are there any fixtures, ducts and pipes suspended over the working areas in such a way that drip or condensate from them may contaminate foods, raw-material or food contact surfaces?		
6.1.11	Is there adequate lighting?		
6.1.12	Are the light bulbs/tube lights etc. of the safety type or otherwise protected to prevent contamination in case of breakages?		
6.1.13	Is the flow of product rapid, orderly and satisfactory?		
6.1.14	Is the processing hall provided with exhaust fans to remove foul air?		
6.1.15	Is there adequate feet and hand washing facility?		
6.1.16	Is adequate quantity of soap and detergent provided?		
6.1.17	Is drainage adequate?		
6.2	Tables and Utensils		
6.2.1	Is the processing table top constructed of stainless steel or any other non-corroding, non-contaminating, non-reacting a-nd nonabsorbent material? (specify)		
6.2.2	Are the tables so constructed that the top and under surfaces can be easily cleaned?		
6.2.3	Are the table tops smooth, free from corrosion, pits and crevices which inhibit satisfactory sanitisation?		

		Yes/No	Remarks
6.2.4	Is any wood used in the fabrication of the work table?		
6.2.5	Are all receptacles, trays, tanks vats and utensils used for processing, of non-corrodible material, other than wood, and have smooth surfaces free from cracks and crevices?		
6.2.6	Are any galvanised iron vessels, bamboo baskets or wire-meshed containers or enamelled or painted wares used for handling the product?		
6.2.7	Is there a certified weighing scale provided with necessary certified weights?		
6.2.8	Is the weighing scale and measures kept clean?		
6.2.9	Are containers with material stacked one above the other causing product contamination?		
6.2.10	Are any insecticides and rodenticide kept in the processing hall?		
6.2.11	Is an ice crusher provided, used and maintained cleanly?		
6.2.12	Is any chemical, preservative, disinfectant, packing materials, utensils etc. not in use, stored in the processing hall?		
6.2.13	Is the processing hall kept neat and tidy?		
6.2.14	Is a cleaning schedule prescribed and adhered to?		

		Yes/No	Remarks
6.3	Water and Ice		
6.3.1	Is potable water available in adequate quantities?		
6.3.2	If the source of water is other than protected water supply system, whether a certificate of potability issued by any recognised institution has been produced?		
6.3.3	If non-potable water is used for washing, is there any cross-connection of potable and non-potable water?		
6.3.4	Is the water supply adequate for peak loads?		
6.3.5	Is the water used for processing chlorinated to the acceptable lvel?		
6.3.6	If there is a storage tank, whether it is protected from dust, birds etc?		
63.7	Is it cleaned periodically and kept in hygienic condition?		
6.3.8	Is water tested regularly? If so how often?		
6.3.9	Is ice made from water of approved source?		
6.3.10	Is water used for ice manufacture chlorinated?		
6.3.11	Are any chemicals or antibiotics used in manufacture of ice? If so, give details		
6.3.12	Are ice blocks handled hygienically inside the processing hall?		
6.3.13	Is ice used for processing obtained from external source? If so, whether the quality of that ice is satisfactory?		

		Yes/No	Remarks
6.4.16	Any other aspects that might cause sanitary problems (specify)		
7.1	Freezing		
7.1.1	Type of freezing employed- a) Tunnel freezing b) Contact freezing c) Any other type		
7.1.2	What is the refrigerant used?		
7.1.3	Total No. of freezers and their nominal capacities		
7.1.4	Is all your production frozen in your freezers? If not, give details		
7.1.5	Are the gauges and thermometers in working order?		
7.1.6	Time taken for reducing the temperature at the centre of the slab to -23°C		
7.1.7	Is the freezer cleaned after each unloading?		
7.2	Canning		
7.2.1	No. of exhaust machines and their capacities		
7.2.2	Are they maintained in good sanitary and working condition?		
7.2.3	What is the temp. at the centre of the can immediately after exhausting?		
7.2.4	Is the blanching tank made of stainless steel?		
7.2.5	What is the time employed for exhausting?		
7.2.6	What is the concentration of blanching brine?		

		Yes/No	Remarks
7.2.7	Is concentration of chemical in blanching solution satisfactory?		
7.2.8	Is the salt and chemicals of approved quality?		
7.2.9	Is blanching done sufficiently?		
7.2.10	What is the composition of filling brine?		
7.2.11	What is the temp. of filling brine?		
7.2.12	Are the packed weight and drained weight maintained properly?		
7.2.13	Type of fuel used for boiler		
7.2.14	Is the capacity of the boiler adequate to meet the installed capacity for production?		
7.2.15	Is the retort equipped with pressure and temp. gauges?		
7.2.16	Is the thermometer of the retort in working condition?		
7.2.17	Is the pressure gauge of retort in working condition?		
7.2.18	Is the vent valve of retort in working condition?		
7.2.19	Is the log book for retort being properly maintained?		
7.2.20	No. of seaming machines		
7,2.21	Type of seaming machines		
7.2.22	Are the seaming machines maintained in proper working condition?		
7.2.23	Is the seam thickness satisfactory?		
7.2.24	Is any clunching operation done?		

		Yes/No	Remarks
7.2.25	Is the plant providied with a coding machine?		
7.2.26	Type of coding machines		
7.2.27	Is the coding machine adequate to emboss codes as per requirements?		
7.2.28	Is the sanitary condition of the cooling tank satisfactory?		
7.2.29	Is the cooling water adequately chlorinated?		
7.2.30	Is the plant having device for continuous chlorination?		
7.2.31	Is there any device to keep the water in the cooling tank in continuous circulation to maintain the temperature?		
7.2.32	Whether spray cooling system is employed?		
7.2.33	Is the plant provided with automatic labelling machine?		
7.2.34	Are the cans rendered rustproof by suitable treatment?		
8	Packing and storage		
8A.1	Is separate area provided for packing?		
8A.2	How long do the unloaded frozen slabs remain in unpacked condition?		
8A.3	Do the packaging material conform to specification?		

		Yes/No	Remarks
8A.4	No. of cold storages and their capacities		
8A.5	Is the capacity adequate for production?		
8A.6	Is cold storage provided with self-recording dial thermometer or any other thermometer (specify)?		
8A.7	Is the cooling system of forced circulation type?		
8A.8	Is any air condition or air-cooling by fan employed?		
8A.9	Is a log book properly maintained?		
8A.10	Are the sides and floors of cold storage fitted with wooden frame?		
8A.11	Are the floors and shelves cleaned periodically?		
8A.12	Are the cartons properly stacked to ensure adequate circulation?		
8A.13	Is there adequate lighting?		
8A.14	Is the store provided with alarm bell in working condition?		
8A.15	Are the workers employed in the cold store using suitable protective clothing?		
8A.16	Is the cold storage defrosted periodically?		
8A.17	Are the plant rooms kept clean?		
8A.18	Does the feeder for electricity have more than one source at nearest sub-station?		

		Yes/No	Remarks
8A.19	In case of power failure, is there any alternate arrangement for power supply?		
8A.20	If so, how often is the generating apparatus tested?		
8A.21	Any other aspect that might cause sanitary problems (specify)		
B	Canned Goods		
8B.1	Is separate area provided for packing?		
8B.2	Do the packaging material conform to specifications?		
8B.3	Is the storage capacity adequate		
8B.4	Are the floors and shelves cleaned periodically?		
8B.5	Is there adequate lighting?		
8B.6	Are the cartons properly stacked?		
9.0	Toilet Facilities		
9.1	Are the number of toilets provided adequate in relation to the total No. of workers?		
9.2	Are the toilets located at a proper distance away in relation from the processing area to prevent air borne contamination?		
9.3	Are the toilets and fittings of sanitary design?		
9.4	Are they provided with self-locking doors, fly-proofing arrangement?		
9.5	Are they provided with wash basin, soap, adequate water supply and flushing arrangements?		

		Yes/No	Remarks
9.6	Are they disinfected daily and maintained in sanitary manner?		
9.7	Are there sign boards directing employees to clean their hands with soap or detergents after using toilet?		
10.0	Personnel Hygiene		
10.1	Does the plant management interest themselves in the overall sanitary and personnel hygiene of the employees?		
10.2	Are the workers apparently free from any form of communicable diseases, open sores and wounds or any other source of contamination?		
10.3	Are the workers medically examined periodically and records thereof maintained?		
10.4	Has it been made obligatory for all employees to notify incidents of typhoid, dysentery diarrhoea or any other notifiable diseases in their homes?		
10.5	Are workers medically examined after each absence due to illness from any contageous disease?		
10.6	Do all employees working in direct contact with food processing or surfaces coming in contact with food		
10.6.1	Wear clean outer garments?		
10.6.2	Maintain a high degree of personnel cleanliness?		
10.6.3	Conform to hygienic practices while on duty?		

		Yes/No	Remarks
10.6.4	Wash their hands thoroughly:- a) before starting work b) after each absence from work station c) at any other time when hands may have become soiled or contaminated		
10.6.5	wear any ornaments on hands?		
10.6.6	wear hair nets/headgears?		
10.6.7	have properly trimmed nails?		
10.6.8	Store clothing or other personal belongings, eat, drink or use tobacco in any form, in the food processing areas?		
10.7	Is any particular person made responsible for plant sanitation and personnel hygiene?		
10.8	Any other aspects that might cause sanitary problems (specify)		
11	Other Amenities		
11.1	Is there a cafeteria/canteen?		
11.2	Is it kept clean?		
11.3	Is there a rest room/dressing room?		
11.4	Is it kept clean?		
11.5	Is there a Quality Control room?		
11.6	If so, is it provided with all required facilities?		
11.7	Is the establishment having a laboratory?		

		Yes/No	Remarks
11.8	If so, is it adequately equipped to carry out all routine tests?		
12	Results of test samples drawn		
12.1	Water		
12.2	Ice		
12.3	Raw material		
12.4	Swabs from		
	Tables		
	Utensils		
	Freezing tray		
	Workers' hands		
12.5	Finished product		
13	Any other point of special interest		
14	Recommendations		

Place: Signature:

Date : Name:

Designation:

Signature of Exporter/Processor or)
his authorised Representative)

/_____/

Rvn

HOW TO CHLORINATE WATER CORRECTLY

The concentration of sodium hypochlorite available from the market is not fixed but usually varies with different samples. So the quantities of the hypochlorite required for chlorinating known volumes of water at the required levels vary in case of different samples. The correct quantities of sodium hypochlorite to be taken in case of samples of different concentrations to chlorinate known volumes of water at two different levels (5 ppm & 100 ppm) are given in the following pages.

....ii)

Quantity of water to be chlorinated in litres	QUANTITY OF SODIUM HYPOCHLORITE REQUIRED (in milli litres) SODIUM HYPOCHLORITE OF CONCENTRATION TO CHLORINATE AT THE LEVEL OF				
	1%	2%	3%	4%	5%
	5 ppm 100 ppm	5 ppm 100 ppm	5 ppm 100 ppm	5 ppm 100 ppm	5 ppm 100 ppm
	(1)	(2)	(3)	(4)	(5)
1	0.50 10	0.25 5.00	0.16 3.20	0.12 2.50	0.10 2.00
2	1.00 20	0.50 10	0.32 6.40	0.25 5.00	0.20 4.00
3	1.50 30	0.75 15	0.48 9.60	0.37 7.50	0.30 6.00
4	2.00 40	1.00 20	0.64 12.80	0.50 10.00	0.40 8.00
5	2.50 50	1.25 25	0.80 16.00	0.62 12.50	0.50 10.00
6	3.00 60	1.50 30	0.96 19.20	0.75 15.00	0.60 12
7	3.50 70	1.75 35	1.12 22.40	0.87 17.50	0.70 14
8	4.00 80	2.00 40	1.28 25.60	1.00 20.00	0.80 16
9	4.50 90	2.25 45	1.44 28.80	1.12 22.50	0.90 18
10	5.00 100	2.50 50	1.60 32.00	1.25 25	1.00 20

....iii)

Quantity of water to be chlorinated in litres	(1)	(2)	(3)	(4)	(5)
20	10.00 200	5.00 100	3.20 64.00	2.50 50	2.00 40
30	15.00 300	7.50 150	4.80 96.00	3.75 75	3.00 60
40	20.00 400	10.00 200	6.40 128	5.00 100	4.00 80
50	25.00 500	12.50 250	8.00 160	6.25 125	5.00 100
60	30.00 600	15.00 300	9.60 192	7.50 150	6.00 120
70	35.00 700	17.50 350	11.20 224	8.75 175	7.00 140
80	40.00 800	20.00 400	12.80 256	10.00 200	8.00 160
90	45.00 900	22.50 450	14.40 288	11.25 228	9.00 180
100	50.00 1000	25.00 500	16.00 320	12.50 250	10.00 200

....iv)

Quantity of water to be chlorinated in litres	6%	7%	8%	9%	10%
	5 ppm 100 ppm	5 ppm 100 ppm	5 ppm 100 ppm	5 ppm 100 ppm	5 ppm 100 ppm
	(6)	(7)	(8)	(9)	(10)
1	0.08 1.60	0.07 1.40	0.06 1.25	0.05 1.10	0.05 1.00
2	0.16 3.20	0.14 2.80	0.12 2.50	0.11 2.20	0.10 2.00
3	0.24 4.80	0.21 4.20	0.18 3.75	0.16 3.30	0.15 3.00
4	0.32 6.40	0.28 5.60	0.25 5.00	0.22 4.40	0.20 4.00
5	0.40 8.00	0.35 7.00	0.31 6.25	0.27 5.50	0.25 5.00
6	0.48 9.60	0.42 8.40	0.37 7.50	0.33 6.60	0.30 6.00
7	0.56 11.20	0.49 9.80	0.43 8.75	0.38 7.70	0.35 7.00
8	0.64 12.80	0.56 11.20	0.50 10.00	0.44 8.80	0.40 8.00
9	0.72 14.40	0.63 12.60	0.56 11.25	0.49 9.90	0.45 9.00
10	0.80 16	0.70 14.00	0.62 12.50	0.55 11.00	0.50 10

....v)

Quantity of water to be chlorinated in litres	(6)	(7)	(8)	(9)	(10)
20	1.60 32	1.40 28	1.25 25	1.10 22	1.00 20
30	2.40 48	2.10 42	1.87 37.5	1.65 33	1.50 30
40	3.20 64	2.80 56	2.50 50	2.20 44	2.00 40
50	4.00 80	3.50 70	3.12 62.5	2.75 55	2.50 50
60	4.80 96	4.20 84	3.75 75	3.30 66	3.00 60
70	5.60 112	4.90 98	4.87 87.5	3.85 77	3.50 70
80	6.40 128	5.60 112	5.00 100	4.40 88	4.00 80
90	7.20 144	6.30 126	5.62 112.5	4.95 99	4.50 90
100	8.00 160	7.00 140	6.25 125	5.50 110	5.00 100

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